

HIRAM SMITH HALL—WISCONSIN DAIRY SCHOOL BUILDING

CHEDDAR CHEESE MAKING

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TABLE OF CONTENTS.

PART I.

	PAGE.
CHAP. I. Milk.....	1
CHAP. II. The fermentations of Milk.....	6
CHAP. III. The rennet test.....	14
CHAP. IV. First steps in cheese making.....	24
CHAP. V. Cutting the curd.....	28
CHAP. VI. Heating the curd.....	31
CHAP. VII. Drawing the whey; or, Dipping the curd.....	36
CHAP. VIII. Milling the curd.....	44
CHAP. IX. Salting the curd.....	51
CHAP. X. Pressing the curd.....	56
CHAP. XI. Curing of the cheese.....	68
CHAP. XII. Shipping the cheese.....	77
CHAP. XIII. Judging cheese.....	82

PART II.

CHAP. I. Construction of factories.....	88
CHAP. II. Equipment of factories.....	100
CHAP. III. Milk testing.....	105
CHAP. IV. Hints on operating the factory.....	118
CHAP. V. The milk producer's responsibility.	122
CHAP. VI. Organization of Cheese Factory Association.....	126

PART III.

Questions on Part I and Part II.....	132
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PREFACE TO SECOND EDITION.

In the past few years great advances have been made in cheese making, and for the old rule of thumb, definite scientific reasons have been substituted.

During the first three years of the Wisconsin Dairy School, the theoretical part of the instruction in cheese making was given by a series of lectures and quizzes along with the practical work.

All books treating on cheese making were either out of date, because of the rapid advance in knowledge on the subject, or were unfitted for use as text books in a school.

The instructor has learned by experience that in order to have the students properly grasp the subject before them, they must have a text book for use along with the lectures and quizzes, in short, with the advent of dairy schools, cheese making in pedagogic form was a necessity.

There are other cheese makers who are not students in dairy schools and it was hoped that they might also find information in the book that would help them. This was proven to be true by the rapidity with which the first edition was exhausted, and the present edition has been revised with a view to more fully meeting the needs of such persons.

Part I deals with the fermentations of milk and the process of making.

Part II deals with the construction and operation of factories.

Part III consists of questions which are answered in the text of parts I and II. The page on which the answer to the question may be found is indicated at the end of the question.

Important Points are indicated by paragraph headings, and usually the answer can be immediately found by glancing at these.

The writer believes that the questions in Part III will not only be helpful to students of dairy schools in mastering the subject, but that they will also be of aid to all students of cheese making.

A careful study of the questions is urged, however simple they may seem, as an accurate knowledge of the details and the reasons why, of the various steps in the process is absolutely necessary in order to master the profession.

CHAPTER I.

MILK.

Composition of Milk. Milk is a secretion of mammals for the nourishment of their young. If we examine the milks of different mammals, we will find that they are composed of the same substances, but that these substances vary in their proportions, as will be seen from the following table giving the composition of milks from different origins:

	Human.	Cow.	Mare.	Goat.	Ewe.	Sow
Albuminoids (protein compound)	2.5	3.2	1.7	5.0	4.5	6.2
Fat	3.6	3.7	.8	3.7	4.2	5.8
Milk Sugar	6.5	4.8	8.8	4.5	5.0	5.3
Ash (chiefly Phosphates)....	.5	.7	.4	.6	.7	.9
Total solids.....	13.1	12.4	11.7	13.8	14.4	18.2
Water.....	86.9	87.6	88.3	86.2	85.6	81.8

As American cheese is made from cows' milk only, no consideration will be given any of the other kinds of milk.

That we may have a better idea of milk, let us look at the nature of the substances in its composition.

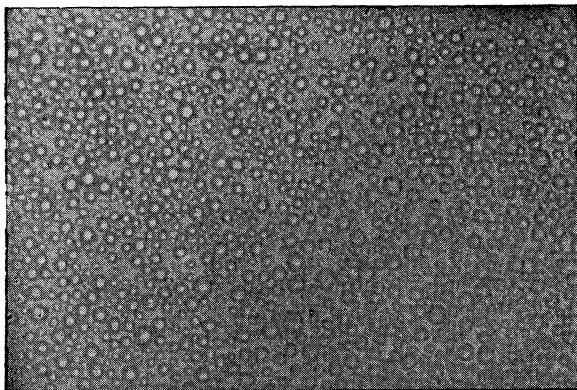
Albuminoids. The albuminoids or protein compounds contain about sixteen per cent. of nitrogen, and are the muscle forming part of the milk.

Milk Sugar. The sugar of milk crystallizes in hard crystals, which are neither as soluble nor as sweet as cane or ordinary sugar. Commercial milk sugar is used largely in the manufacture of lactated foods.

Ash. The ash is the mineral substance left when milk is burned. Chemical analysis shows it to consist largely of phosphates. The ash is the bone-forming part of the milk.

Water. The albuminoids,* milk sugar and ash are all in solution in the eighty-seven per cent. of water.

Fat. The fat of the milk is not in solution, but in the form of little globules suspended in the liquid portion, which form is called an emulsion.

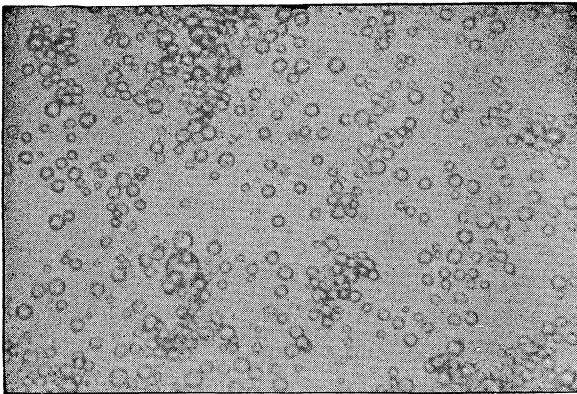


MICROSCOPIC MILK AS DRAWN FROM THE COW.

The globules vary in size from one two-thousandth to one ten-thousandth of an inch in diameter. By one ten-thousandth of an inch is meant that it would take ten thousand of these little globules placed side by side to make a row an inch long.

*The casein, which is an albuminoid, is thought by some authorities not to be in solution, but in the form of a thin gelatinous mass. This point however is disputed, and for all practical purposes we can speak of it as in solution.

Colostrum Milk. The first milk given by a cow just after calving is called colostrum milk, and is much more viscous than normal milk, sometimes being nearly as thick as syrup. The components of the milk are not in their normal proportions, the albuminoids sometimes amounting to fifteen per cent. of the milk, while the fat may be less than two per cent. Under the microscope, cells which have scaled off from the inside of the udder can be seen floating about, and while these dead particles of tissue are in the milk, it is unfit for cheese. After four or five milkings the milk will appear normal, but it should not be used for a week.



MICROSCOPIC MILK AFTER STANDING A SHORT TIME.

When milk is taken into the calf's stomach, it is digested by the juices secreted by the same. If we take a stomach and soak it in water or brine, two ferments, rennet and pepsin, the active principles in digestion, are dissolved; and if we add this solution to

milk, the milk will be curdled. The part of the milk that is curdled is the casein, which is the larger portion of the albuminoids. About one-fourth of the albuminous substance in the milk is like the white of an egg, and is not coagulated by rennet. By heating the whey after the casein has been first coagulated, this part will be precipitated, and therefore seems to be identical with the albumen of an egg, which is also coagulated by heat, as is seen in cooking, and is called lactalbumen.

Whey. In the manufacture of cheese the milk is curdled by rennet, and the curd cut into small pieces from which the liquid portion, or whey, is expelled. The whey then is the major part of the water of the milk, which carries with it nearly all the soluble portions, namely: the albumen, milk sugar, ash, and also a small portion of the fat, as the very small globules break away from the curd in cutting it.

Curd. The curd, or green cheese, is the coagulated casein which holds in its meshes most of the fat, some water, and small portions of the albumen, milk sugar and ash. The water in green cheese is about one-third of its weight. We look upon green cheese and curd as identical, for green cheese is simply curd pressed together.

Fat Necessary for Cheese. While the casein may be said to be the cheesy part of the milk, still the quantity and quality of the cheese produced is greatly affected by the quantity of fat present in the milk; in fact, the real value of milk for cheese is determined by the amount of fat it contains. Without the fat the

casein will dry out very rapidly and become very hard. The fat not only helps the casein to hold the water from excessive evaporation, but it seems to increase the capacity of it for absorbing water.

CHAPTER II.

THE FERMENTATIONS OF MILK.

Cheese making a Process of Fermentation. The process of cheese making is a process of fermentation from beginning to end. It will therefore be necessary to consider the different kinds of ferments, and how they act in the process. There are two general kinds of ferment, namely: organized and unorganized.

Organized Ferments. The organized ferments are so called because they are the result of the growth of minute vegetable organisms. There are millions of these organisms in the milk, and in their growth they decompose the components of the milk, forming varying decomposition products. Nearly all the trouble we have in cheese making is due to the action of definite living vegetable cells that have the power of manufacturing certain decomposition products; on the other hand, we could not produce fine cheese without the presence of certain forms of bacteria that are able to change the milk, producing the fine desired flavors.

Lactic Ferment. The souring of milk is produced by the growth of particular species of organized ferments. These organisms so affect the milk sugar that it is changed into lactic acid. When the lactic fermentation is not properly handled and there is too much lactic acid formed in the curd, we have a sour cheese, and on

the other hand when the curd is put to press before the lactic fermentation has run its course, gas is produced, which forms large, round, smooth holes, termed "Swiss holes," so-called because they resemble the holes found in Swiss cheese.

Important Point in Cheese making. *The most important point in cheese making is to know how to control the lactic fermentations.*

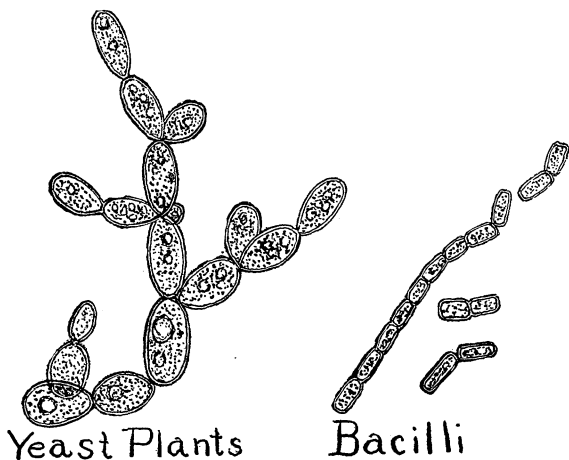
Pinholey Curds due to Bacteria. But the ordinary souring of milk, or lactic fermentation as it is called, is not the only fermentation due to germs or bacteria. Through the action of the lactic ferment the milk sugar is decomposed, but in other fermentations the casein is attacked, and gas formed that collects in little holes about the size of the head of a pin, and such a curd is therefore known as "pinholey."

Butyric Ferment. Bacteriologists have separated quite a number of peculiar ferments that are produced by distinct species of bacteria; for instance, there is the butyric fermentation, in which butyric acid is the decomposition product formed, and the alcoholic fermentation in which alcohol and carbonic acid gas are formed.

Bitter Milk — How Caused. There is also sometimes a bitter taste to milk which usually goes with the butyric fermentation, but bacteriologists have shown it to be the result of a distinct fermentation.

Alkaline Fermentation. Another peculiar fermentation of milk is the alkaline curdling, in which the milk curdles apparently in the same manner as in or-

dinary souring, but it shows a distinct alkaline reaction. "Ropy" and "slimy" milk are also fermentations that are brought about by the action of bacteria.



Bacteria. It has been said that these fermentations are due to minute living organisms. They are, in fact, little plants consisting of but a single cell, and these little cells live and grow in a similar way as do larger plants that we can see without a microscope.

On the outside is the cell wall which resembles the shell surrounding an egg. Inside of the cell wall is the protoplasm, or living element of the organism. Some of these single cells are spherical in form, and are known as cocci (singular, coccus), others are rod-like, and are called bacilli (singular, bacillus), meaning a rod, and the yeasts or *saccharomyces*, which grow in sugar solutions and are oval in form, are still another

class. The protoplasm or living element inside of the cell wall is sensitive to light and heat just as in the higher order of plants; in fact, these characteristics are the characteristics of life, and anæsthetics, such as chloroform and ether, will cause a cessation of their vital activities, and the fermentation ceases entirely because the protoplasm is killed, or is suspended until the irritating agent is removed.

Difference between Organized and Unorganized Ferments. This is the distinguishing difference between organized and unorganized ferments, the latter class not being affected by anæsthetics. For instance, rennet will curdle milk, and its action is hastened or retarded according to the temperature of the milk, the same as organized ferments, but it is not affected by these protoplasmic poisons.

Rennet is a good representative of the unorganized ferments or enzymes, as they are called, with which we have to deal in cheese making.

Enzymes. The enzymes do not seem to be living organisms, but are more like a chemical in their action. On the other hand, they hardly seem to be purely chemical, for a chemical will be used up by entering into another combination, but an enzyme may be used over and over again.

Enzymes sometimes produced by Organized Ferments. While enzymes are distinct from organized ferments, they are often produced as a result of the growth of certain organisms. In the alkaline curdling of milk, mentioned among the organized ferments,

there is an enzyme produced as a result of the growth of the bacteria, and then the curdling is accomplished by the enzyme in a manner similar to, if not quite identical with that of rennet. Rennet and pepsin, the active part of the rennet extract used in cheese making, are both enzymes.

Rennet, where found. Rennet which was first isolated by Hammersten, is found in the stomachs of calves, lambs and pigs, and also in birds and fishes, and in some plants.

It will be remembered, by referring to the table showing the composition of milk, that there is 0.7 per cent. ash in cow's milk, which is a comparatively small quantity.

Phosphates required. Part of this ash is in the form of phosphates, and though small in quantity, rennet will not curdle the milk without their presence. It is thought that casein forms a chemical combination with the phosphates in the form known as casein tricalcium phosphate, which is soluble, but when rennet is added to the milk, it is changed to calcium phosphate and an insoluble casein compound which is the cheese.

Effect of Salt on Milk. If common salt or magnesium sulphate is added to the milk in sufficient quantity, the casein will be precipitated.

Effect of Heat on Rennet. Rennet will not curdle milk at a very low temperature, but as the temperature is raised it will begin to work and act with increasing rapidity until at a point above 100° F. it is

injured. By putting cold rennet into warm milk it may work faster up to 120° or 130° F., but when the rennet in weak solutions is heated to 105° F. it begins to be injured. A strong solution may be held at 150° for fifteen minutes without being entirely destroyed, but it will be rendered much weaker. These high temperatures do not destroy the power of the rennet instantly but gradually.

Rennet does not Exhaust Itself. As has been said concerning enzymes, rennet does not seem to spend its energy, but will act over and over again. If we coagulate a quantity of milk, and apply the whey to a like quantity of milk, the milk will be coagulated; we could do this indefinitely, if it were not for getting a larger volume of whey than we have of milk.

Effect of Acidity on the Action of Rennet. It has been said that the rapidity in the action of rennet is greatly affected by the temperature of the milk, but we will find, if the temperature of the milk is held constant, the more lactic acid there is in the milk the faster the rennet will act, or if any acid be artificially added to the milk in quantities not sufficient to coagulate it, the action of the rennet will be hastened, and on the other hand if alkali be added to the milk, the action of the rennet will be retarded.

Rennet Extracts not alike. Another cause for varying rapidity of action is the difference in the strength of the rennet extract used. Rennets vary as to the amount of ferment contained in them, and it is

next to impossible to get two lots of rennet extract exactly alike.

Rennet is sometimes concentrated in the form of tablets or rennet powder, but even these vary in strength, and they are concentrated to such a degree that it is difficult to measure them closely, and on that account extract is preferable.

What Rennet Extract is. Rennet extract is a solution of rennet and pepsin in strong brine. A rennet, as we buy it on the market, is a calf's stomach, which has been cleaned and filled with salt and allowed to dry. The best rennets come from Bavaria.

How Rennet Extract is Made. Rennet extract is made in the following manner:

Prepare a sufficient number of rennets, say five hundred, by splitting them open so that the water can get into them. Then take an oak barrel and put the rennets into it, and fill with water until they are well covered.

Possibly the barrel might be nearly filled with water, but we should not have more water than is necessary to dissolve the ferment.

A little salt should be added to the water, say three pounds of salt to one hundred pounds of water. The rennets should be stirred up and pounded every day, to facilitate the solution of the ferment, and at the end of a week the liquid should be drawn off and the rennets wrung out with a clothes wringer. They should be put into water again and soaked for another week, and the same operation gone through with. As

a usual thing, the ferment has not all been extracted from the stomachs till they have been soaked for four weeks. The liquid that has been obtained by soaking the rennets should be filtered through clean straw, charcoal and sand, and then an excess of salt added to preserve it.

The extract should be clear though of a dark color. The first sign of the decomposition of rennet extract is a muddy appearance.

If extract is ever prepared by the cheese-maker, enough to last the whole season should be made in the spring when the weather is cool, and then it should be kept in a cool place.

Reliable Brands to be Preferred. The surest way of getting extract that can be depended on, is to buy some reliable brand of extract, such as Hansen's.

The practice of preparing extract every few days is wrong, as the strength of each new lot will not be like the last, and if used in about the same quantities the cheese will not cure evenly. The use of whey as a solvent for the rennet is wrong for reasons that are obvious after considering the subject of organized ferments.

A comparison of extracts and their relative value, will be taken up after the rennet test has been explained.

CHAPTER III.

THE RENNET TEST.

Cause of Uneven Cheese. Cheese makers have had trouble in getting their cheese even in quality. If the milk came in cold in the morning and the rennet was added to it immediately on warming it up to the proper temperature, the development of acid was retarded; and if they put it to press before sufficient acid had been formed, they would get a sweet flavored cheese full of "Swiss holes." If the curd was held in the whey long enough for proper development of acid, the chances were that it would become whey-soaked, and a leaky sour cheese would be formed. Or if the milk was over ripe, it would work too fast and the cheese would be sour.

As early as fifty years ago, in England, the cheese makers began to learn that if milk was cold, they would obtain better results by warming it up to 90° F. and allowing it to ripen before adding the rennet; but while it improved the quality of the cheese, it did not always help them out of the difficulty.

Rennet Action dependent on Three Things. It has been shown that the rapidity with which rennet coagulates milk is dependent on:—

1. The strength of the rennet extract.
2. The temperature of the milk.
3. The acidity of the milk.

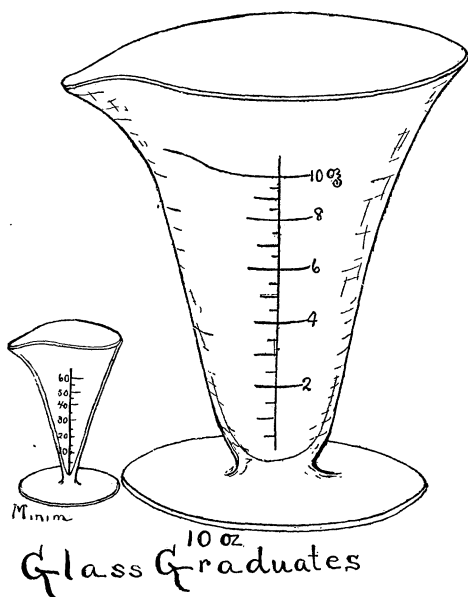
Now if we use the same rennet, at the same temperature of the milk each time, the variation in the rapidity with which it coagulates the milk, must be due solely to the acidity or ripeness of the milk.

J. B. Harris discovers the Rennet Test. About ten years ago J. B. Harris conceived this idea, and used a teacupful of milk from the vat, to which he added a teaspoonful of rennet and noted the number of seconds required to coagulate the milk. When the milk was ripened down to a certain number of seconds, he found that he could foretell approximately the time that it would take for acid to develop.

Rennet a Powerful Agent. But if one stops a moment to figure on it, he will see that rennet is a very powerful agent. If one uses four ounces of extract to one thousand pounds of milk, it is one part of rennet to four thousand of milk, and sometimes the proportion will be as wide as one to sixteen thousand. It will be easily seen that since the rennet is such a powerful agent, it is not likely to be an entirely accurate test where a teaspoon is used for measuring the rennet, for then it would be difficult to measure exactly twice alike. Therefore, in place of the teaspoon, a minim or dram graduate was substituted, and for the tea cup an eight ounce glass graduate such as druggists use. This was much better than the other crude apparatus for making the test.

Glass Graduates for Measuring. But the minim graduate is funnel shaped, and the top being broad in proportion to its volume, the chances for error are

still too great in measuring. In actual practice through haste in making the test, two or three drops of extract were likely to be left in the narrow bot-

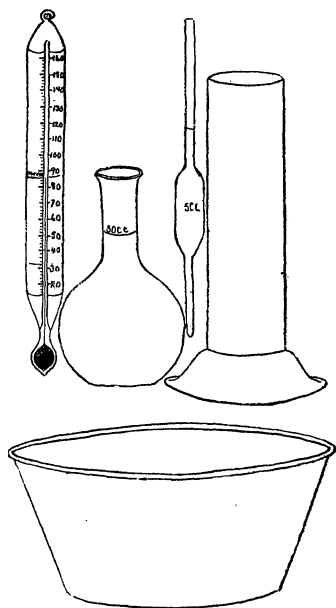


tom of the minim graduate, and the maker would be confused in not getting the results he expected by depending on it.

J. H. Monrad then proposed a new set of apparatus, which, though not so simple, leaves less chance for error.

The Monrad Rennet Test. The apparatus for the Monrad test, as used at the Wisconsin Dairy School, consists of a 160 c.c. tin cylinder for measuring the

milk, a 5 c. c. pipette, a 50 c. c. glass flask, and a half pint tin basin. By filling the tin cylinder full it always gives the right measure of milk quickly. Measuring the milk in a glass graduate is difficult, as it is hard to get the milk just to the mark, and if the glass is covered with white milk it is difficult to see the mark.



MONRAD RENNET TEST.

The rennet is first measured with the 5 c. c. pipette. A pipette (as will be seen by reference to the illustration), is a glass tube with a mark on it indicating the volume of 5 c. c., and the rennet can very easily be measured to the mark, and the tube being narrow makes the measurement accurate. The rennet in the

pipette is delivered into the 50 c. c. flask, and what little rennet adheres to the inside of the pipette is rinsed into the flask. This is then filled with water to the 50 c. c. mark on the neck, and the solution mixed by shaking. The milk, the temperature of which should be 86° F., measured in the tin cylinder, is emptied into the half pint basin, and 5 c. c. of the dilute extract is measured into the 160 c. c. of milk, and the number of seconds required to curdle it noted. If a few specks of charcoal are scattered on the milk and the milk started into motion around the dish with a thermometer, the instant of curdling can be noted by the stopping of the specks. They will stop so suddenly as to seem to start back in the opposite direction.

Use Thermometer to Stir Milk. By using a thermometer, the temperature can be constantly watched; and if the temperature should fall, it can quickly be brought back to 86° F. by setting the basin in a pail of warm water for five seconds.

Ripening the Milk. If the milk is ripened so as to coagulate in the same number of seconds each day, one can tell very closely the time when the whey can be drawn off from the curd. It should be ripened to a point where in two hours from the time the rennet is added to the milk there will be "one-eighth of an inch of acid" on the curd, as we shall see later on.

With the rennet extract we have been using at the Wisconsin Dairy School, the milk when ripened to thirty seconds works off in about the right time, but the extract is very strong, one ounce being sufficient

to coagulate one thousand pounds of milk in twenty minutes. If however our rennet extract was so weak that it would take four ounces of it to coagulate one thousand pounds of the same milk in twenty minutes, it would be only one-fourth as strong as the rennet we have been using, and the milk would then have to be ripened so as to coagulate in one hundred and twenty seconds instead of thirty.

How to Ripen Milk to the Right Point. Starting in with the season's work the cheese maker has nothing to guide him as to the ripeness of the milk, simply because he does not know the strength of the rennet extract at his disposal. The first day he makes cheese, he must make a rennet test of his milk at the time he sets it and then observe how the milk acts. If the milk is too sweet, he can calculate about how much riper it must be to work just right, and in a few days he will have the matter entirely under his control. Cheese makers should never neglect to use the rennet test, for it enables them to judge definitely the condition of their milk.

When a maker is troubled with tainted milk it is often necessary to ripen a little lower than with good milk, for the bad flavor, as we have already learned, is due to some harmful variety of bacteria which choke out the lactic ferments.

Use of a Starter. In such cases it is well to use a starter to make the lactic ferment overcome the other ferment. (See p. 24.)

Comparisons of Rennet Extracts. Sometimes, as has been previously shown, it will take three or four ounces of one kind of rennet extract to coagulate one thousand pounds of milk at the same temperature and time, as it would take one ounce of another extract. Perhaps the weaker extract is offered for sale at a lower price. By using the rennet test to compare the two kinds of extract, one can tell their relative values.

How to compare Milks. In comparing two lots of milk, for that is just what we do with the rennet test, we must have all the conditions other than the milk the same; that is, we must use the same extract, at the same temperature every time, and the test will tell us the strength of acid in the milk.

Now if we want to compare two kinds of rennet extract, we must have all the conditions but the extract the same; that is, we must make the tests at the same temperature, on the same milk, and at the same time, for the milk will be ripening and introducing an error if we wait. When these conditions are followed the test gives us the comparative strength of two kinds of rennet extract, and we can afford to pay for them in proportion to their strength with perhaps a preference for the stronger extract, other things being equal, for the stronger extract will invariably keep better.

An Example in Cost of Extract. Suppose two kinds of extract, A and B, are offered to us and the price of A is \$1.50 and B \$1.25 per gallon. On mak-

ing comparative tests of them, we find that A coagulates the milk in thirty seconds and B in fifty seconds.

Which extract is the cheaper?

We simply put the problem into an inverse proportion. $30 : 50 :: x : \$1.50$.

The product of the means equals the product of the extremes.

$$\begin{aligned} 50x &= \$45.00 \\ x &= .90 \end{aligned}$$

From which we find that we can afford to pay 90 cents for B extract and \$1.25 is too much for it.

An Example Requiring Time for the Answer.

Let us continue the above example. Suppose after stating the comparative rennet tests of A and B extract the question asked was, if four ounces of A will coagulate 1,000 lbs. of milk at 86° F. in twenty minutes, how long will it take five ounces of B? We cannot compare four ounces of A with five ounces of B directly for they are not of the same strength. The first step will be to find how long it will take four ounces of B, and having found it we can in the next step compare four ounces of B with five ounces of B. When we use 1,000 lbs. of milk and four ounces of rennet, we are simply making a rennet test on a large scale, and A and B will have the same ratio as though 160 c. c. of milk and .5 c. c. of rennet were used.

First step. We put down our first ratio $30 : 50$. As x , the time it will take four ounces of B extract, will be greater than twenty minutes, we put x in the fourth place, and our proportion reads $30 : 50 :: 20 : x$.

The product of the means equals the product of the extremes

$$\therefore 30x = 1,000$$

$$x = 33\frac{1}{3} \text{ minutes,}$$

the time required for four ounces of B to coagulate 1,000 lbs. of milk.

Second step. If four ounces of B will coagulate the milk in $33\frac{1}{3}$ minutes, five ounces will coagulate it in less time than four ounces. We accordingly make the following proportion:

$$4 : 5 :: x : 33\frac{1}{3}$$

$$5x = 133\frac{1}{3}$$

$$x = 26\frac{2}{3} \text{ minutes Q. E. D.}$$

An example requiring quantity for an answer.

Continuing the example how much A extract will be required to coagulate 1,000 lbs. of milk at 86° F. in thirty minutes?

If it takes four ounces twenty minutes, less will be required to coagulate in thirty minutes. We take our first ratio 20 : 30. As x the term we are seeking is to be less than four we put it in the third term. Our proportion is then:

$$20 : 30 :: x : 4$$

$$30x = 80$$

$$x = 2.66 + \text{oz. Q. E. D.}$$

Having now seen that all rennet extract is not alike, it is evident that when a cheese maker says he uses three ounces or four ounces of rennet extract per thousand pounds of milk, he gives no definite information. If he says he uses enough to coagulate his milk

at 86° F. in twenty minutes, it is at once clear what he means.

How Strength of Rennet Should be Expressed.

The strength of rennet should always be spoken of in terms of time and temperature, and not in quantity. For instance; if we want to make a fast curing cheese we should say: "We use enough rennet to coagulate the milk in fifteen to twenty minutes at 86° F." ; and if we want to make a slow curing cheese we should say: "Enough to coagulate in thirty to forty minutes at 86° F."

CHAPTER IV.

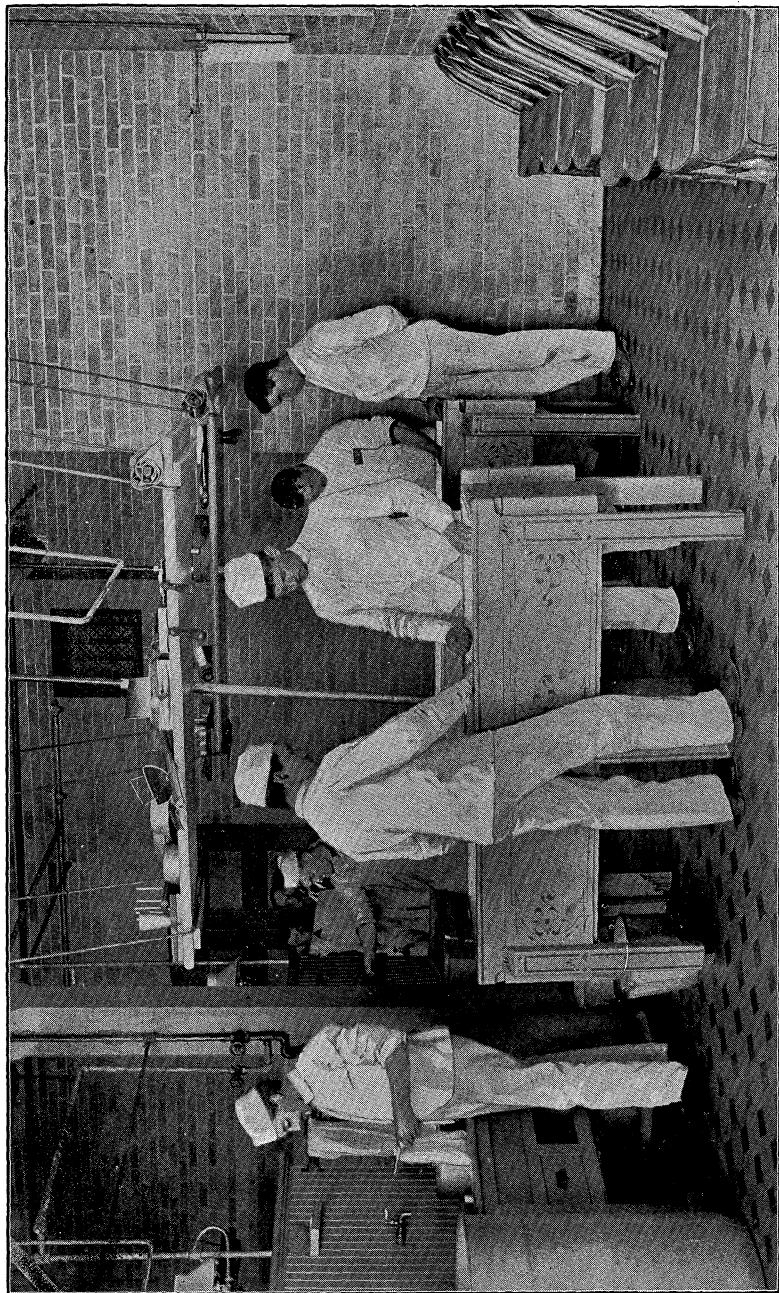
FIRST STEPS IN CHEESE MAKING.

Stir Milk to Keep Cream Down. While the milk is being received it should be stirred in the vat to keep the cream down. As soon as the milk has all been received and the quantity figured up, the steam should be turned on and the milk heated to 86° F., and a rennet test made. If the cheese maker is suspicious that the milk may be over ripe, he should make a rennet test before the milk in the vat is heated up to 86° F., by taking his sample for the rennet test in the basin in which the test is made and warming it up in a pail of warm water.

If the milk is found to be over ripe, he will have to hurry the process to keep ahead of the fermentation. On the other hand, if he finds the milk very sweet, and that he will have to wait an hour or more for it to ripen down, he should use a starter.

Definition of a Starter. A starter is simply a small quantity of milk in which the lactic fermentation has been allowed to develop, and there are therefore millions upon millions of the desired kinds of bacteria in it, and when these are put into the milk in the vat, they increase very rapidly and hasten the ripening of the milk.

What to use for a Starter. The starter should be saved from some patron's milk from the morning or



STUDENTS MAKING CHEESE—WISCONSIN DAIRY SCHOOL

evening before, and should always be the best flavored milk, for the whole vat will be made like it.

By adding about half water to the starter milk in the evening it will not curdle so but that it will mix nicely in the vat.

What not to use for a Starter. A starter should not be saved from the vat of milk nor the whey, for the starter will then be likely to contain all sorts of germs, good, bad, and indifferent, and these will all be transmitted from one day's milk to the next; in fact, a bad disease might be carried through the milk in this way for a whole season. Thick milk may be used for a starter, if one is hard pressed, but it is better not to let the starter get quite thick. If the starter is thick, it should be strained carefully through a cloth strainer, for if clots of thick starter get into the vat of milk, they will not be colored and may leave white specks in the curd.

Milk should be ripened to a point where in two hours from the time the rennet is added to the milk, there will be one-eighth of an inch of acid on the curd. What is meant by an eighth of an inch of acid will be explained further on.

Milk must not be too Ripe. Milk should never be allowed to ripen to a point where it will work too fast. In such cases there will be too great a loss of fat in the whey, and a small yield of cheese.

Adding the Color. Until lately cheese color has been made from the annatto seed grown in South America. Cheaper and stronger color is now being

made from aniline, a coal tar product. The public seems to be prejudiced against mineral coloring, but there is so little of it in the cheese that we doubt if it is injurious to health. Personally we like the looks of an uncolored cheese best.

Different markets require different shades. It seems to be a general rule that the farther south we go the higher the color that is required. Chicago calls for a straw color. St. Louis wants it higher, and New Orleans higher still.

The color should be added before the rennet. It should be diluted with water and stirred in thoroughly. In the cheese it should not be of a reddish hue.

Setting the Milk. Having gotten our milk into the proper condition we are now ready to set it. It should be set at 86° F. As sometimes happens, the milk may have accidentally been warmed up to 90°. We should rather set the milk at that temperature than wait to cool it down, for the milk will be ripening while we delay setting it. The only objection to setting milk at 90° is that the curd hardens too fast to cut it conveniently. If it were not for that fact, I see no objection to setting it at 98°.

For a fast curing cheese we should use enough rennet to curdle the milk in fifteen to twenty minutes; and for a slow curing cheese enough to curdle in thirty to forty minutes.

Rennet should be Diluted. The rennet should be diluted, not with milk, (why?) but with a dipperful or pailful of water, and then poured into the vat evenly

from one end to the other. The water should be about 90° F. If above 100° F. the rennet will be weakened. The milk should have been thoroughly stirred just previous to adding the rennet, and then the rennet should be thoroughly mixed with the milk. The stirring should be done gently so that the fat will not separate from the milk.

The milk should be kept in motion for several minutes; the surface should then be stirred gently with the bottom of the dipper so that the cream will not rise on the surface, and the milk will set, or coagulate, and hold it down. The movement of the dipper should be kept up for about half the time it takes the milk to coagulate, and then a cover should be put over the vat to keep the surface of the milk from cooling off.

When the Curd is ready to Cut. The curd is ready to cut when it will break clean before the finger. The index finger is thrust into the curd and pushed along through it about half an inch below the surface. The curd is first split by the thumb, and when the proper firmness is reached it will break as the finger is pushed along. If the break is clean, that is, does not leave milky but clear whey in the break, the curd is ready to be cut.

CHAPTER V.

CUTTING THE CURD.

Through the work of heat and rennet the curd contracts and expels the whey. In order that this may be more readily done, we cut the curd into small cubes and raise the temperature. The pieces of curd must be of the same size and shape, so that they may expel the whey evenly.

How to Cut a Fast working Curd. When we have a fast working or over ripe curd we cut finer and heat faster than with a normal working curd.

The English cheese-makers used to break the curd, first with their hands, and then with wires, but the curd-knife has entirely superseded that method. There are two forms of knives used in the operation.

Use of Horizontal Curd-Knife. The first is the horizontal knife, which has eighteen or twenty blades. When it is drawn through the length of the vat, it will cut the curd into layers or blankets one half-inch thick, by six inches wide, by the length of the vat long. Care must be taken not to jam the curd, for if it is jammed it will be lost in the whey. The flat sides of the blades should not be forced into the curd to get the knife into a position to cut it, for they will jam the curd in so doing.

How to Insert the Horizontal Knife. The length of the knife is therefore held in a horizontal position,

the upper end of the knife near the handle resting on the top of the end of the vat. The knife is then swung down into the curd, the edges of the blades cutting into the curd and taking a circular course till the



HORIZONTAL KNIFE.

knife has assumed a vertical position parallel with the end of the vat, the lower end of the knife resting on the bottom of the vat. In this movement we have not jammed the curd, but have the knife in a position to move it through the length of the vat and cut the curd into the layers. But these layers are only six inches wide and we will have to cut the whole vat of curd into these layers. Then keeping the knife in the curd we must turn it without breaking the curd, so that we can run the knife to the other end of the vat. Using the side of the knife next to the uncut curd as a center, we turn the knife around through 180° of a circle, and we are ready to carry the knife to the other end of the vat.

How to take the Knife out. When we have cut the vat of the curd all up into blankets, we take the knife out in the reverse order to which it went in.

The horizontal knife is now laid aside and the operation finished with the perpendicular knife. The blades in this knife run in the direction of the longest dimension of the knife.

We do not, like some cheese makers, wait here for the whey to rise over the curd before finishing the

operation, for the pieces of curd will get out of place, and the curd being harder will not be so easily cut.



PERPENDICULAR
KNIFE.

How to insert the Perpendicular Knife. We start cutting in the same place as we did with the other knife, inserting it in the curd in the same way, for it has cross braces which are really horizontal blades, and we must avoid jamming the curd with them. We draw the knife over the same course that the other knife went, and we have the curd cut into strips one-half inch square and the length of the vat long.

We then cut cross-wise of the vat, being careful not to jam the curd, and we then have it cut into half inch cubes.

If we are making up slow working milk, this amount of cutting may be enough, but if it is necessary to cut finer, it can be done by cutting alternately lengthwise and crosswise of the vat. The strokes should be much quicker now, as the curd has been getting harder and finer and will pass between the blades, and a quick stroke is therefore necessary to cut it.

Rapidity of Stroke a Factor. When a cheese maker says he cuts a curd a certain number of times, he does not convey the proper idea, for the rapidity of his strokes is a great factor, and if he cuts lengthwise of the vat six times and crosswise six times, and cuts with a slow motion, the curd may not be cut any finer than if it had been cut only four times each way with a quick stroke.

CHAPTER VI.

HEATING THE CURD.

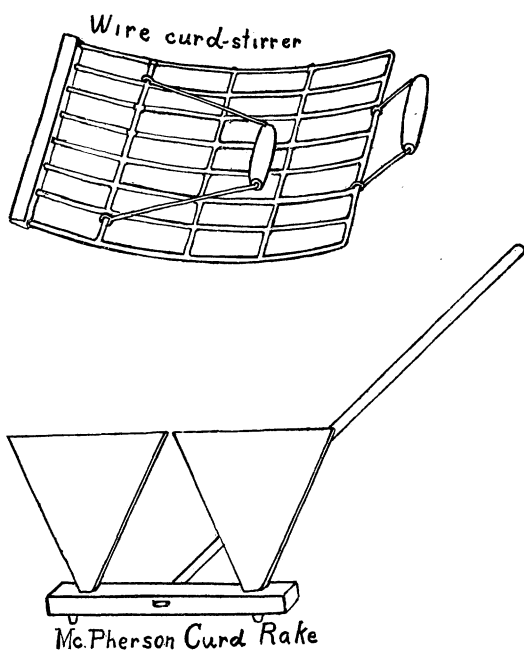
Keep Curd Moving. As has been said, the curd was cut to allow the whey to escape, but if the curd is not kept moving, it will settle to the bottom of the vat and mat together again. Therefore, as soon as the curd has been cut, begin stirring the curd by hand or with a wire basket made for the purpose.

Do not allow the curd to collect in the corners of the vat, and be sure and rub it off from the sides of the vat or it will scald on. The whey should look clear, and be as free as possible from specks of curd floating in it.

When to Begin Heating. Curd being a poor conductor of heat, one degree in five minutes is fast enough to heat normal working milk. If it is heated too fast, it will cook the particles on the outside and hold the whey inside of them; and the result will be a mottled whey-soaked cheese. The curd does not expel the whey as fast at 86° F to 90° F. as it does at a little higher temperature, so that the temperature should be applied slowly at first.

Cooking an Over Ripe Curd. If the milk is over ripe, however, it expels the whey faster, and the curd must be heated faster and higher than normal working curd, or there will be the required amount of acid on

the curd before it is hard enough to remove it from the whey. As a usual thing it is not necessary to cook a curd above ninety-eight degrees, but a curd must be cooked before drawing the whey, no matter if the temperature has to be raised to one hundred and ten degrees to do it. (For definition of cooked curd see p. 35.) It is necessary to cook a fast working curd in



that way, and if the curd is taking acid too rapidly for the heating in the whey to be sufficient to firm the curd before the acid is too great, the whey can be drawn and the remainder of the firming done in warm water, which is run into the vat in place of the whey.

The water dilutes the acid so that it will not have such a bad effect, and at the same time the curd is kept apart and warm so that the whey in it can be thoroughly expelled. It must not be forgotten, however, that an over ripe milk will not yield as well as though it were normal, for the acid dissolves the casein as is seen in the milky whey when too much acid has been developed.

“Corky Cheese.” If the acid comes too slow, it may not be necessary to cook above 96° F., for if the curd were to be held at 98° for too long a time, too much whey would be expelled, the same as though a normal ripening curd were held at 110° for half an hour. The curd would be too dry and resemble skim-milk curd or sawdust, and the cheese would cure very slowly because of the lack of moisture; it would be said to be “corky” because it resembles cork in texture. If one uses the rennet test carefully, he will know just how fast his curd will work and at what temperature to cook it.

Use Correct Thermometers. It is very essential to have a correct thermometer. The cheap floating thermometers that are usually sold may be five or six degrees wrong. The flange thermometers are not so handy to use in the vat but are more likely to be correct; the glass tube, however, may get loose and slip down the scale giving a misleading temperature. The best way to get a good thermometer is to pay a good fair price, say one or two dollars and buy one that is guaranteed to be correct.

Stirring the Curd. To assist the curd in heating evenly and keep it from matting together, it should be stirred from the time it is cut till it is cooked. Some Canadian factories have a steam stirring apparatus which is very handy, but in most factories it is done with a rake.

Curd Rakes. There are two kinds of curd rakes in use, the common wooden hay rake and the McPherson curd-rake.

The rake is put into the whey as soon as the steam is turned on, and the curd is started into a rolling motion as though it were boiling. The stirring is commenced with the rake, teeth up, at one end of the vat, and the rake is worked down the length of the vat, making the curd roll on the side of the vat opposite the operator; then back again, making it roll on the side toward him. Care should be taken that curd does not collect in the corners of the vat; nor should it be allowed to roll up into little balls. On the other hand it must not be jammed, or fat will be lost in the whey at the expense of the yield of cheese.

McPherson Curd Rake. The McPherson rake has large triangular teeth with the base of the triangle forming the end of the tooth. This form of rake makes it much easier to give the curd a rolling motion. Some rakes have only two large teeth, and others several, but smaller ones. It is well to have two short wooden pins about a half to three-quarters of an inch long, in the back of the rake, to prevent its jamming the curd on the bottom of the vat.

How to tell a Proper Cook. One of the most important steps in the process is to know when a curd is cooked enough. We should then have one-eighth of an inch of acid on the curd, and draw the whey. Here it will be seen that our judgment comes into play to know how fast to heat a curd, to have it just firm enough when the acid comes. The rennet test will help us to regulate this, but if the rennet test tells us we have a fast working milk, we must cook faster, and perhaps higher. When we draw the whey, the curd must not be salvy and soft, but when a big double handful is pressed together in the hands, and one hand removed, it should not remain in a mashed up mass, but should fall apart readily. The particles of curd should be examined from time to time, to see that they are cooking on the inside as well as the outside.

CHAPTER VII.

DRAWING THE WHEY—DIPPING THE CURD.

As has been said, when there is an eighth of an inch of acid on the curd, the whey should be drawn off.

Measuring Acid. Strictly speaking, we cannot measure acid by the inch, but the acid seems to act on the curd in some way, so that when a piece is touched to a hot iron and drawn away, it will leave fine, silky threads behind, sticking to the iron. With normal working milk, when the curd is first cooked up, it will not string at all; but when the acid has reached a certain strength, it will begin to string, at first barely sticking to the iron, and as the acid increases, the strings will get longer, till they may be several inches in length.

Threads Due to Acid. That the threads are in no way due to the rennet, but are dependent on the acid, is shown when milk sours naturally. Such a sour milk curd will usually string on a hot iron. If acid is introduced into the milk in sufficient quantity to curdle it, the curd will likely string. In fact, strings of any desired length can be produced, by adding the right quantity of acid to the milk. However, if too much acid is added, it will make a soft, mushy curd, which will not string. In the natural curdling of milk, where the acid develops in sufficient quantity, we get just such a soft, mushy curd, that will not string.

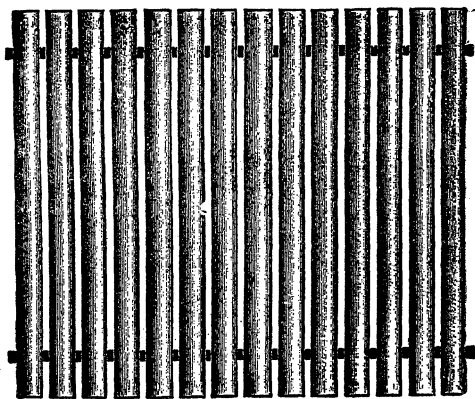
Result of Too Much Acid. Not only is this the result in cheese making, when too much acid is developed in the whey, but there is also a great loss of fat. Experience has taught us, that as a usual thing we cannot let the curd take more than one-eighth of an inch of acid in the whey without disastrous results. If we were to wait but a short time after we have strings an eighth of an inch long, we would find perhaps, that they had increased to an inch in length, and our curd would be ruined. It is therefore necessary, that one should work nimbly at this stage of the process. Not only should the whey be drawn off from the curd, but the curd must also be thoroughly drained, for whey in the curd will have the same effect as though the curd were still in the whey. Of course the curd must contain its natural amount of moisture, but there must be no pools of free whey in or on the curd.

In the old system of granular cheese making, the curd was stirred over in the bottom of the vat, and then a ditch made in the middle for it to drain. In this stirring, considerable fat was lost, and the curds were not uniform in moisture. The reason of this was, that they were stirred drier one day than another.

Curd Rack. In the system distinctly known as the cheddar system, which we follow, the curd is drained on racks, which are placed either in the bottom of the vat or in a curd sink. The racks are made of hard wood, preferably maple. They are constructed of strips rounded on the top, three-fourths of an inch thick, two inches wide, screwed onto two other pieces two inches high, three-fourths of an inch thick, and

four feet long. The slats are three-eighths of an inch apart, and extend crosswise of the vat, and are long enough, so that not more than a quarter of an inch of space is left between each end and the sides of the vat. The racks are usually in two four-foot sections.

Racks, How Used. When the whey is drawn down, so that there is but very little whey left in the vat to interfere with operations, the vat is tipped so that one end is five or six inches lower than the other, and the curd is shoved down to the lower end till about five



CURD RACK.

feet of the upper end is cleared. The first section of the rack is then put in, and a linen strainer cloth thrown over it. This strainer cloth should be about twelve feet long, and wide enough (60 inches) to come up over the sides of the vat. The surplus cloth is then tucked under the lower end of the rack, and the curd piled onto it and broken apart to allow the whey to escape.

It should be stirred over several times, and then left to mat evenly about six inches deep. The space, formerly occupied by the curd that has been put onto the racks, is now clear, and the second section of the rack can be placed in the vat. This is put in close to the first section, and the cloth that had been tucked out of the way, is drawn over it and covered with curd, care being taken, as on the first section, to stir out the whey. The sides and ends of the strainer cloth are then wrapped over the curd, and the vat covered with a heavy cloth cover to keep the curd warm. The temperature must be maintained, to keep fermentation going on.

Cutting the Curd into Blocks. After ten or fifteen minutes, the curd will have matted together, and can be cut into large blocks, which are turned over. The best instrument for cutting the curd is a wooden butter spade, which will cut the curd but not the cloth. The curd can be cut once or twice down the length of the vat, and across the vat, into pieces eight inches wide.

Turning the Curd. Begin at the lower end to turn the curd, for it will be more convenient to place the hands under the curd on the side toward the upper end of the vat, and roll it over. In so doing, it is not necessary to lift the piece, thereby breaking it. Continue turning the other pieces in the same manner, till the last piece at the upper end of the vat is reached, then, by a pull of the cloth, it is turned over. Cover it up and let it stand to mat still closer. By using

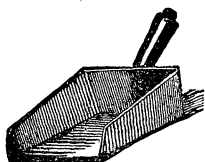
racks, the whey runs through when the curd is turned over. Watch the curd, and if whey should collect between the pieces, turn them over and let it run off. The curd should be turned over from time to time, but much oftener at first, to facilitate the expulsion of the whey. After a while the curd will begin to get a grain to it, and will tear like the meat on a chicken's breast.

Pin-hole Curds. If we have what is called a "gassy" or "pin-hole" curd, the gas will begin to form in little holes about the size of a pin head. Through the flattening of the curd, these holes are flattened and the gas escapes. Sometimes these pin holes appear before the curd is taken out of the whey, and, if they are plentiful enough, the curd will float on the surface of the whey, and we have what is called a "floater." But this does not occur very often, if we draw the whey in time. It used to occur quite often with bad milk, when the curd was left in the granular form, and more acid was run in the whey. The pin holes were not flattened, and consequently appeared in the cheese. Such curds are often accompanied by a bad flavor. They are probably caused from bad ferments, but may be due to bad flavored food. Clover and watercress, when eaten by the cows, have been known to give a curd with pin holes.

Some of the taints are much more persistent than others. As a usual thing, a taint can not be gotten entirely out of the cheese.

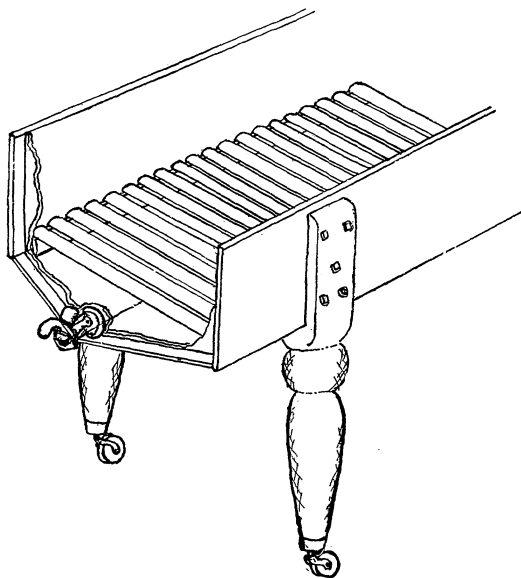
Washing Curds. A curd can be greatly improved by washing it. When put onto the racks, and before

it has had time to mat, a few pails of water at a temperature of 105° F. will wash out a great deal of the taint. Sometimes taints, due to the feeding of turnips, cabbages, and like foods are met with. In such cases, potassium nitrate, commonly called salt peter, has been used to prevent the flavor showing in the cheese.



CURD SCOOP.

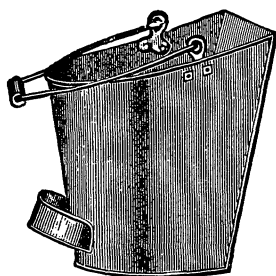
I do not like the idea of using such things, as they are injurious to health. If foods like turnips are fed to cattle, they should be fed in small quantities just after milking, and the results will not show in the milk.



CURD SINK.

Use of a Curd Sink. It is much easier to get the curd onto the racks and expel the whey, by using a curd sink. Nor is as much fat lost in the operation, for where the curd mats together in the vat before it can be gotten onto the racks, it is necessary to break it apart to let the whey out, and the necessary bruising forces the fat out of it.

Proper Form of Curd Sink. The common form of curd sink, with an opening along the whole length of the bottom, is to be avoided. The sink should be a tin lined box with a channel bottom. There should be racks in it, and the channel under the racks will leave a place for hot water, to keep the curd warm. There should be a faucet at the lower end that can be opened to let the whey drain off, and then closed to



CURD PAIL.

keep the water under the curd. If the racks are not used, the curd will not drain sufficiently; and if there is an opening along the bottom, there will be a current of air started up around the curd which will be cooled. Of course this is just what we must avoid, because the fermentation will be checked, if the curd cools down.

How to fill the Curd Sink. When the curd sink is used, the whey should be drawn down in the vat till it just barely covers the curd; for while it is covered with whey, it will not mat. The curd sink is then run to the lower end of the vat, and the curd dipped over onto the racks in the curd sink. All the whey

runs through, and the curd is left dry to mat properly. If the curd is tainted, it can be more thoroughly washed, as the curd is not matted together, and the water will wash all around the particles. As the curd is filled into the sink, this can be moved along, and the curd filled into it evenly.

After the curd has been turned several times, the maker can begin piling it. He can pile it two, three, or five or six layers deep, but he should keep the pieces pretty well together, so that the curd will not spread too much at first.

Keep the Curd Warm. The pieces that have been on the outside of the pile should be placed on the inside, so that the temperature may be kept even. We must not forget the fact, that cheese-making is a process of fermentation, and that heat is a great factor in it.

Piling Curds. Piling the curd has a tendency to make a fast-curing, soft or "weak-bodied," cheese. If a fast-curing, soft cheese is desired, then the curd should be piled, but if a slow-curing, firm-bodied cheese is desired, we should pile the curd very little or not at all. In many of the best Canadian factories, the curd is not piled at all, but is turned over and over. A curd, from over ripe milk, should not be piled very much, as such a curd is likely to produce a "salvy" cheese.

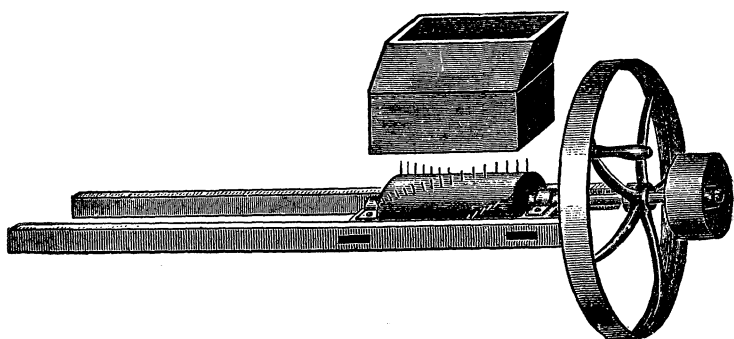
CHAPTER VIII.

MILLING THE CURD.

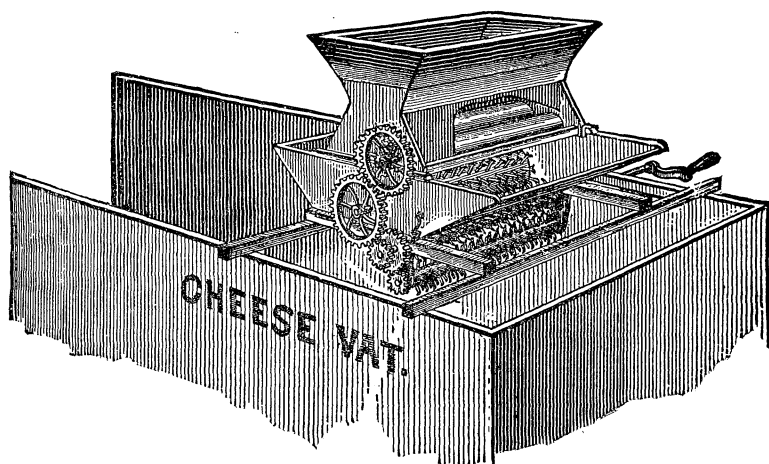
When a Curd is Ready to Mill. In the course of an hour and a half from the time the curd has been dipped onto the racks, it will have matted down, and assumed a meaty texture. It will not tear out in chunks, but in strips like the meat on a chicken's breast. There will also probably be half an inch or more, likely an inch, of fine strings, when tried on a hot iron. It is then ready to grind or mill, that is, it is put into a curd mill and cut into small pieces. The acid should be developing well at this stage of the process, but the amount of acid is not so important as that the curd shall be meaty in texture.

Description of Curd Mills. The first curd mills were used in England. They consisted of a hopper, in the bottom of which was a roller with iron pegs in it. Sometimes there were two rollers. On the side of the hopper were iron pegs, and when the curd was thrown into it, the pegs in the roller would catch it, and carry it against the pegs, and tear and squeeze it to pieces.

The old Roe mill is made on this principle. The old Elgin mill was also on the same plan, only there was less room for the curd to get between the pegs, and the curd was badly smashed and jammed. It helped to get rid of the fat, and such a mill ought



PEG MILL.

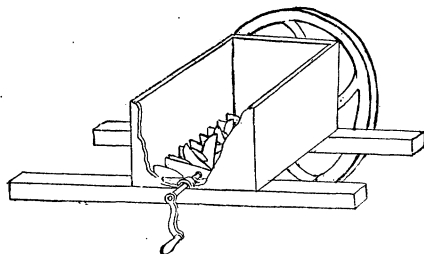


POHL MILL.

never to have been used. The curd mills got a bad reputation from such members of the family as the Elgin mill, and even to-day, it is hard to restore the decent members of the family to the confidence of all cheese makers.

Pohl Mill. The next form of peg mill, which I think is the best peg mill ever invented, is the Pohl mill, which has sharp teeth on two cylinders, revolving at different velocities, which pick the curd to pieces. The objection to this mill is, that it does not leave the curd in the same size pieces. Some of the pieces will be quite large, while others are small, and when salted, the salt will not be evenly distributed. There is a self-salting attachment to the mill, but it is useless, as a curd is never ready to salt when milled.

Whitlow Mill. A knife-mill does not jam the curd as much as a peg-mill does. It simply cuts it. One of the earliest forms of knife-mills was built after the

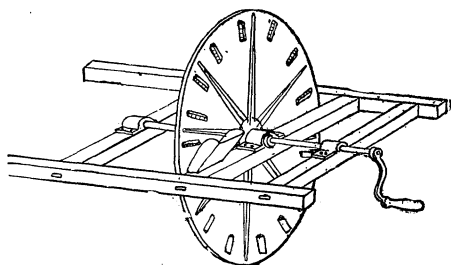


COMMON KNIFE CURD MILL.

form of peg-mills, as is seen in the Whitlow mill of Canada. There are a number of knives on a shaft which play between knives in the side of the hopper. When the curd is put into the hopper, it

is caught between the knives and cut into small pieces.

McPherson Mill. The McPherson mill, invented in Eastern Ontario, consists of a wheel with knives in it similar to the blade of a plane. A hopper feeds



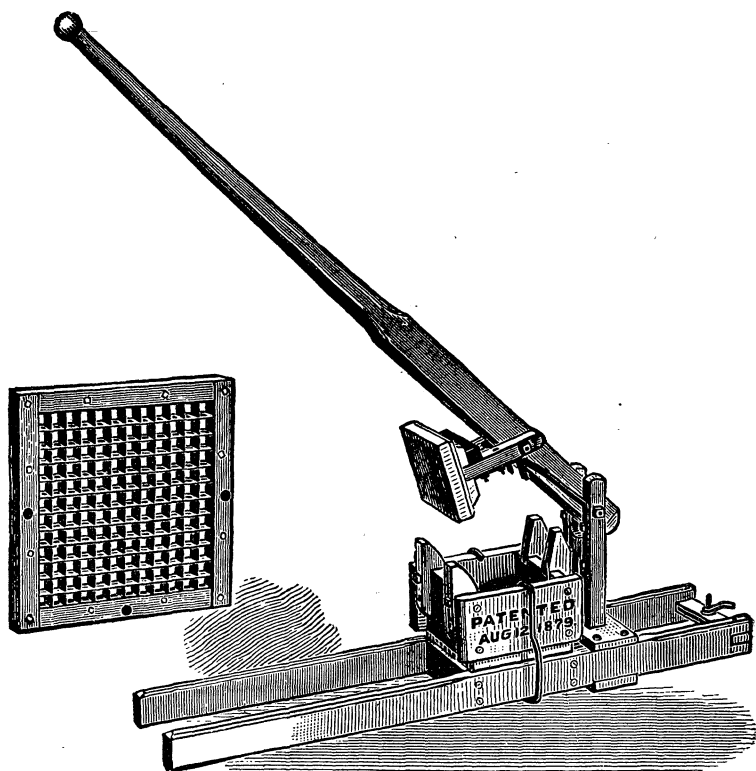
M'PHERSON CURD MILL.

the curd down against the wheel, and as it turns, slices of curd are shaved off. The wheel is apt to make the curd fly.

The Harris Mill. The Harris mill has a network of knives at the bottom of a hopper. A plunger works by a lever into this hopper, and when a chunk of curd is dropped into this, the plunger forces it through the knives, leaving the curd in pieces one-half inch square, and as long as the piece of curd dropped into the hopper.

Caswell Mill. The Caswell mill used in Canada, is really a Harris mill fitted up for power, but instead of cutting the curd into square pieces, they are diamond-shaped. In either of these mills, the curd should be put into the hopper edgewise, so that the strips will be cut in the direction of the grain of the

curd. If there are any holes in the curd the pieces lying across each other will continue to flatten them. The pin holes must be flattened, for as long as they remain round, they will appear in the cheese.



HARRIS CURD MILL.

Advantages and Objections to Knife Mills. The other advantage of a knife-mill, besides saving the fat in the curd, is that the curd will not mat together on the racks, but can easily be torn to pieces by hand. An

objection offered to such mills is, that the curd will not press together well. It may perhaps be difficult at times, but I think the trouble in closing the cheese lies somewhere else. It must be remembered that knife-mills are used, hardly without exception, in factories where the best Canadian cheese is made, and this cheese is shipped to England, where the bandages are often stripped off from them, and they must necessarily be closed.

If the trouble in closing the cheese be carefully investigated I think it will be found to be in the bandage used, or the temperature of the curd.* Some makers let the curd mat together again, and grind a second or third time, but I do not like so much hacking of the curd. The curd should be piled up to flatten the pinholes, and then stirred every fifteen minutes to give it air.

Stirring the Curd. A five-tined fork, with the points turned into little loops to prevent catching into the cloth, or sticking into the sink, is a very handy tool with which to stir the curd. It does the work thoroughly, and with much less labor than with the hands alone.

Time to Mill. I like to have the grinding come about half way in time, from dipping the curd to salting it. It therefore should be an hour and a half from grinding to salting.† During all this time the temperature should be kept up. (Why?)

*If the curd is too warm fat will run in between the pieces and prevent closing. By putting to press at a lower temperature this can usually be avoided.

†Sometimes fat will run freely from a curd as soon as milled. In such a case the curd should be held longer before milling, and salted soon after milling.

We want the curd to take all the acid it will before salting, which is indicated by strings about two inches long on the hot iron.

Effect of Dry Acid. If a fast-curing cheese is wanted, there is all the greater reason for giving it all the acid it will take.

If a cheese is salted before the lactic fermentation has proceeded far enough, Swiss holes will develop.

Do not be afraid of getting a sour cheese by giving it all the *dry* acid it will take. If one has got all the whey out of the curd, there is no danger from too much acid. It is acid in the whey that makes a sour cheese.

How to Expel Gas. If the pin-holes are not all flattened out by the time we are ready to salt the curd, it can be put into the hoops and pressed up for fifteen minutes. Then take it out and pull to pieces by hand or with the fork. This, however, is not necessary except in very stubborn cases. The gas can usually be expelled by thorough airing and piling.

CHAPTER IX.

SALTING THE CURD.

Condition of a Curd for Salting. When ready to salt, the curd when rubbed on the hot iron, should not smell like burnt hair, but like toasted cheese. It should not feel harsh, but soft and silky, and when squeezed in the hand, a mixture of half fat and half whey should run between the fingers.

If it is clear whey that runs out, the curd is not ready to salt. White whey should not run from a curd before salting. In that case it has not been fully freed from whey, and there is a heavy loss of fat. Of course, if the whey is in the curd, it should be gotten rid of, but it ought not to be there. When salted, a clear brine should run from the curd.

Few cheese makers realize how important a step in the process of cheese making the salting of the curd is, and they salt all their curds according to some fixed rule, learned from their predecessors, without knowing what the salt does.

What Salt Is. Salt is known to chemists by the name of sodium chloride. It is a chemical combination of the metal sodium and chlorine gas, in the proportion by weight, of twenty-three parts sodium to thirty-five and a half parts chlorine.

Where Salt Comes From. It occurs in beds in the earth, and is either mined, or more commonly obtained from salt wells, in which the salt is dissolved by the

water, pumped up to the surface, and evaporated, leaving the salt. But salt does not occur pure in these beds.

Impurities in Salt. There are associated with it potassium chloride, calcium chloride, sulphates, magnesia, and lime. The presence of calcium chloride in the salt makes it lumpy and damp, for calcium chloride has a great attraction for water, and will take it from the air. Calcium chloride and magnesium give the salt a bitter taste.

These impurities however, as well as the water contained in salt, are a very low percentage of the whole, and when a salt dealer talks about his salt being so much stronger or purer than any other high grade salt, it is not so. Do not understand however, that common barrel salt is just as good as the best salt for cheese making, for it is not. Common barrel salt contains a great deal of dirt, and salt may take up bad odors, which will be imparted to the cheese.

Fine salt that has probably been ground, and the crystals broken, will dissolve faster than a coarser salt, in the natural crystalline form.

Salts can easily be tested as to quality, by dissolving them in pure water, in a glass cylinder, and shaking up to dissolve. Use more salt than will dissolve. The best salt is that which leaves a clear brine with no scum or dirt on the top, nor dirt in the bottom of the solutions. Cheese is an article of food and we do not want any dirt in it, so we should avoid dirty salt. If a few drops of a solution of ammonium oxalate is poured into the salt solution, any lime that may be in

the salt will be thrown down in the form of a white precipitate of calcium oxalate. By this means we can form an idea of the amount of lime in the salt. I doubt if a little lime (calcium oxide) is harmful in the salt, but if the calcium is in the form of chloride, it will attract moisture and make the salt lump. Lumpy salt will not be evenly distributed in the cheese.

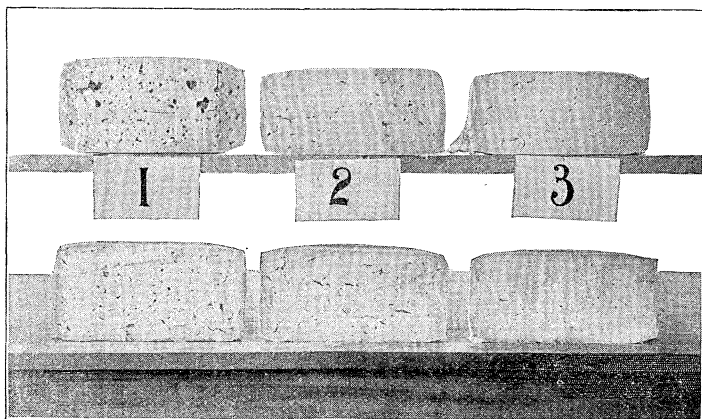
What Salt does to Cheese. In the first place, salt gives taste to a cheese. A cheese without salt has an insipid fresh taste. Salt also takes out the moisture, so that fermentation is checked. A cheese without salt will cure very fast, in fact fermentation goes on so rapidly that gas holes are formed.

The same thing is seen in brick and swiss cheese, in which the fermentation starts in the unsalted state, but the salt, which is applied to the outsides, works its way into the cheese before it gets bad. It should be noted, that such cheese has to be cured in a cellar, where there is a constant low temperature. They would otherwise spoil.

Effect of too much Salt. If a cheese is salted too heavy, it becomes dry and mealy, and cures very slowly. The flavor is also injured. If we have bad milk, we should salt higher to improve the flavor, for up to a certain point, this is accomplished by heavier salting. I believe this to be due to the fact, that as the fermentation is checked by more salt, the gases formed have a chance to diffuse, and get out of the cheese without filling it with holes and the odor of the gases.

We would, therefore, if we wanted to make a fine

flavored cheese, salt it pretty heavy, say three pounds of salt per one hundred of curd. We must expect however, that such a curd will cure slowly. We cannot make the best kind of cheese in a day, a week, nor a month. If one wants a fast curing cheese, he uses more rennet and less salt, but the product will not be as good a cheese. It will not be as close, nor as fine flavored, for the gases will not have had time to escape from the cheese. If one is making a fine, slow curing cheese, he need not expect to get as much cheese per hundred weight of milk, as if he were making fast curing cheese, for the salt expels the moisture and leaves less weight.



Effect of salt in cheese: No. 1, no salt; No. 2, upper row, $1\frac{1}{2}$ pounds; lower row, 2 pounds per 100 pounds of curd; No. 3, 3 pounds per 100 pounds of curd.

In a case which we had in the Wisconsin dairy school, a curd was divided into three equal parts.* The first lot received no salt; the second lot one and a half

*A further discussion of this by the author will be found in the Wis. Experiment Station Eleventh Annual Report.

pounds of salt per cwt.; and the third lot three pounds per cwt. The curds were then pressed separately, and the green cheese weighed as follows:

The cheese with no salt	10 lbs.
The cheese with one and a half lbs. of salt	9.75lbs.
The cheese with three pounds of salt	9.50lbs.

As the cheese cured, they kept their relative weights. Other experiments have borne out this result.

Curds not always Salted the same Amount. But curds should not always be salted at the same rate, from day to day.

A moist curd needs more salt than a dry one, for two reasons: First, the excess of moisture must be expelled by the addition of salt; and second, as the expulsion of moisture takes salt with it in solution, enough must be applied, to leave the proper amount in the cheese.

Salt Should be Evenly Distributed. It is also essential, that the salt should be evenly distributed through the cheese. If there is too much salt in the curd that is put into the hoop last, it will crack the rind of the cheese.

Application of Salt. The curd should be spread out evenly in the curd sink, and a part of the salt scattered evenly over it. The curd should then be stirred thoroughly, and again spread out, and the remainder of the salt applied. It ought to be stirred every ten minutes, to keep the salt from settling to the bottom of the pile, in a brine.

Temperature for Salting. Before salting, it should

have been cooled to 90° F., for if too warm, the fat may be expelled in large quantities with the brine. The curd should not be put to press, till the salt has been thoroughly dissolved and worked into it.

Condition of Salted Curd for Pressing. It will have a harsh feeling, due to the undissolved salt crystals, and the outside of the pieces of curd are hardened, so that they will not press together readily; but as the salt works into the curd, it will regain its velvety feeling. When this condition has been reached, which is usually in fifteen to twenty minutes, it is ready for the press.

CHAPTER X.

PRESSING THE CHEESE.

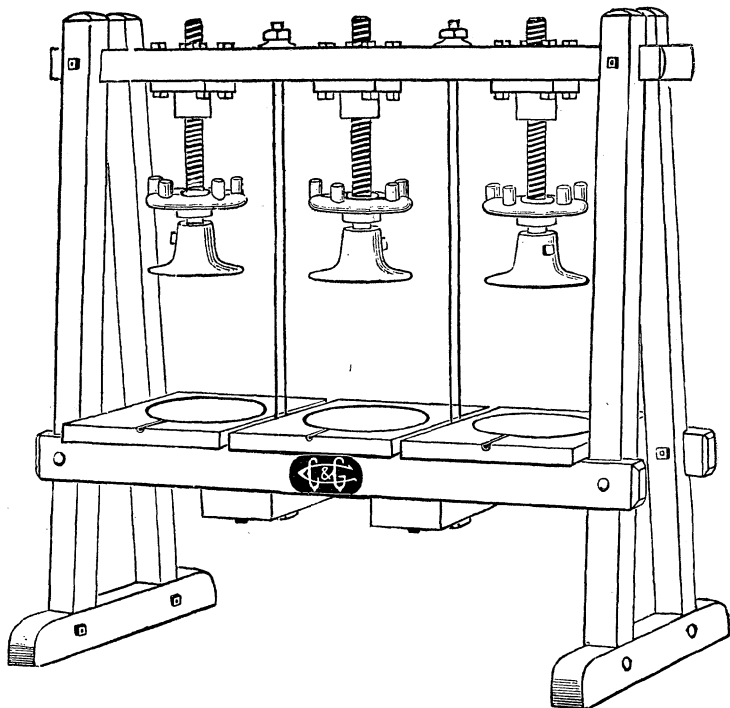
Curd Must Not be too Warm. Before pressing, the curd should be cooled to between eighty and eighty-five degrees. If put to press warmer, the fat runs, and large quantities of it are lost. It also runs between the pieces of curd, so that they will not close together, and under the bandage, preventing it from sticking. Poorly closed cheese has often been blamed to the curd mill, when the trouble really lay in the temperature at which it was put to press.

Curd Must Not be too Cold. Of course, when the curd is much below 80°, it will not close together, but there is a happy medium. This happy medium varies according to the temperature of the press room. If the room is cold, the curd will cool down. A cheese-maker must have some brains in his head, and use them, for he is more than a mere machine to be wound up and run down. A proper temperature for the press room is about 70°.

Common Packages of Cheese. There are three common packages, into which American cheese is pressed, namely, Young Americas, weighing nine or ten pounds, Flats and Cheddars, weighing respectively thirty and sixty pounds.

The common diameter of flats or cheddar cheese is fourteen and a half inches, and a flat is half the height of a cheddar.

There are two kinds of presses used, the gang and the upright. The upright press has the screws in an upright position, and but one screw to a cheese. The gang press has one horizontal screw, which presses any where from one to twenty cheese. The hoops

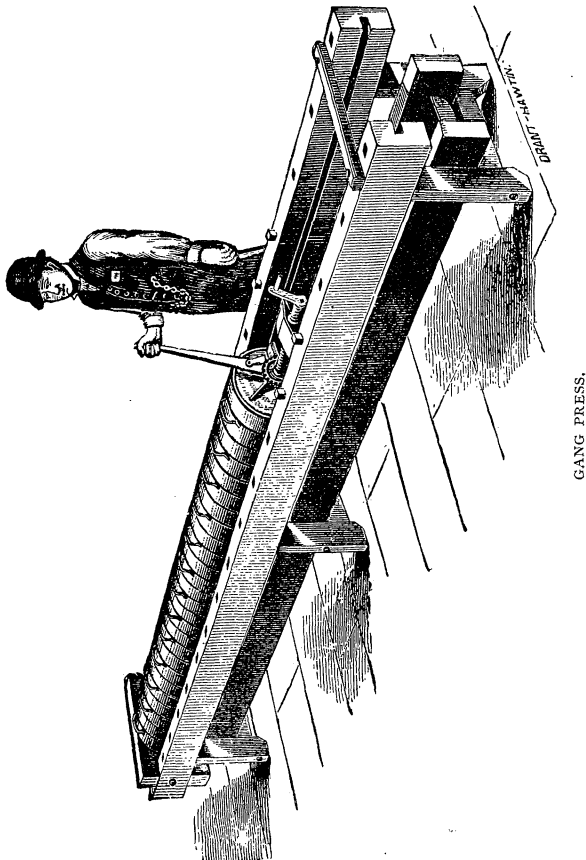


UPRIGHT PREES.

are made a little smaller at the bottom than the top, so that each hoop will fit over the next one in front of it.

The Canadians use the upright presses more than we do in Wisconsin, thinking the pressure will be

kept up better, as there is but one cheese under a screw, but they are hard to keep clean and take up a great deal of room.



There are forms of gang presses,* which keep up a

*D. H. Burrell, Little Falls, N. Y., makes a continuous pressure press, and also a pressure block which can be put into any gang press.

continuous pressure by springs, or a system of levers, which are kept tight by weights.

In the gang hoop, the bandage is held by an iron band, which slips into the top of the hoop. This iron band is called the "bandager."

In pressing the cheese, the maker should aim to turn out a perfect cheese. He should be an artist, and produce an object of beauty. The ends should be square with its height, clean, and the bandage turned down evenly at the ends, and closed well on the sides.

Kinds of Bandage Used. There are two kinds of bandages used, starched and seamless. The starched bandage is made up, from the starched cloth, by the factory man. The seamless bandage comes in the form of a long tube, from which the required length for the cheese is cut. But the starched bandage will not let the whey out properly, and consequently the cheese does not close on the sides. The cheese closes much better with the unstarched, seamless bandage.

Ready-made unstarched bandages of better quality than the seamless bandage and about the same cost are now in the market.

How the Bandage is Put Onto the Cheese. When the bandage is put into the hoop, the edge should be turned in evenly, for about an inch and a half on the bottom, and perhaps dampened to hold its place.

Before putting the bandage in, the bottom cap cloth should be put in. It should be round, and as large as the bottom of the hoop (fourteen and a half inches), and should be soaked in hot water. Square cap cloths

lap over onto the sides of the cheese, and make bad looking scars.

Cheese Must be the Same Size. Care should be taken to put the same amount of curd into each hoop, so that the cheese will all be the same height.

The hoops should not be filled so full that the cheese comes above the junction between the bandage and the hoop, for in such cases, there will be a little ridge left at the junction, which will disfigure the cheese.

When the curd has been filled into the hoop, the top cap cloth is put on, and the fibrous ring laid around the edge, to keep the curd from pushing out, and then the follower put in. Usually the fibrous ring is tacked onto the follower, and while it may fit well, it quite often happens that it does not; and the curd will push out at the places where the ring does not come tight against the hoop. There is another point in having the fibrous ring separate from the follower, which will be noticed when we come to it later on.

Tighten the Press Slowly. After the hoops have been slipped into place, the screw should be tightened slowly, to let the whey out gradually. A small stream of brine should be kept flowing. If too great pressure is applied at first, the fat will be forced out. Curd closes together slowly, as will be seen by squeezing it in the hand. If it be squeezed suddenly, and then the pressure released, it will fall apart, but if pressed up slowly in the hand, it will stick together. We should not have reached the full pressure for about fifteen minutes.

In about an hour, the curd will be pressed together, and then the bandage should be turned down around the top of the cheese. This operation is generally called "dressing" the cheese.

Dressing the Cheese. Set the hoops in an upright position, and take out the followers, cap cloths, and bandagers. Pull the bandage gently, to be sure there are no wrinkles in it, and then trim off evenly all around, so that it will lap over onto the end of the cheese about an inch and a half. Soak it down into position with warm water, and put on the cap, after having wrung it out in warm water. Be sure there are no wrinkles in the cap, for they will leave bad looking marks on the rind of the cheese.

Then put in the bandages to keep the hoops straight in the press, and the fibrous ring and follower, and close up the press, putting on full pressure. Young Americas, however, will not stand as much pressure, for they do not have as much surface as larger cheese, to resist it.

How to get Cheese Dry. The idea, that we make a cheese dry by pressing it, is an erroneous one. The whey has to be gotten out of the curd, while it is in the vat, and if it is not gotten out there, no amount of squeezing in the press will expel it, and the cheese will get sour.

If the press is not a continuous pressure one, as is likely the case, the maker should tighten the press the last thing at night, and the first thing in the morning.

In the morning, the cheese should be taken out of

the hoops and examined, to see if they are perfect in shape, and all defects remedied. If the bandage does not stick, the cheese should be washed with warm water, and after being tightened in the press, hot water turned on to warm it up. If the edge of the upper end of the cheese is rough, it should be turned end for end in the hoop. In either case, the fibrous ring should be left out, so that the edge of the cheese will come out of the hoop square. Of course it must be watched, to see that the cheese does not push out beyond the follower, and its last state be worse than the first; but if the pressure is carefully applied, a nice square edge can be put onto a cheese, in this way.

Do not Pound the Hoops. The cheese should slip out of the hoop with very little pounding. Pounding loosens the rivets, and thereby gets the hoops into bad repair, as well as loosens the bandage on the cheese, and sometimes breaks the cheese.

Where a knife is used to loosen the cheese, the bandage is also often loosened. If the cheese does not slip out easily, grease the hoops. The hoops should of course be kept clean, and if it is necessary to grease them, *clean* grease can be applied.

Cheese should never be taken out on the floor, but on a press board. We must remember that cheese is an article of human food. Most people like to have clean food to eat, and we should aim to be just as clean in making the cheese, as though the consumers were watching all the time.

Wipe the cheese off with a clean cloth, and then put

them on the shelves, marking the date neatly. Cheese with great big marks scrawled over them do not look attractive.

Greasing the Cheese. As soon as the rind has dried off, it should be greased with regular cheese grease. The practice of skimming the whey, after it has fermented and got full of dirt, is nothing less than a dirty trick. Good wholesome grease, prepared for the purpose, can be bought of regular dealers in dairy supplies, and nothing else should be used.

Cracks in Cheese. If the cheese is left exposed to the air too long, before being greased, it will crack. Another cause of the rind cracking is too much acid in the whey. A high acid cheese will, as a rule, crack. A draft of air blowing over the cheese will also cause it to crack. This of course is caused by the air absorbing moisture from the rind. I think, that while the question of moisture in the curing of American cheese has gone almost unconsidered, we must pay more attention to it in the future.

Cheese in Cold Storage. Cheese held in cold storage are very likely to mould, which will work into the cracks, and for this reason buyers do not want cracked cheese. The rinds of high acid cheese, held in cold storage, will also begin to rot at the middle.

Sometimes the maker leaves the caps, or press cloths as they are sometimes called, on, until a few days before shipping, and then pulls them off and greases the rinds.

Sometimes salt sacks made out of heavy ducking are used for caps. This leaves a hard, but very rough

rind, and if the cheese is held in cold storage, and mould grows on it, it is almost impossible to get the mould off, and buyers are strongly opposed to using salt sacks for this purpose.

Cleaning Mouldy Cheese. Cheese that gets mouldy in cold storage, is put into a sink of hot water to which a little ammonia has been added, and scrubbed with a brush. It is put on a shelf to drain and dry, and afterward boxed again.

Cheese Cloth Circles. Sometimes a thin "cap" of cheese cloth, or a "cheese cloth circle," is put onto the end of the cheese.

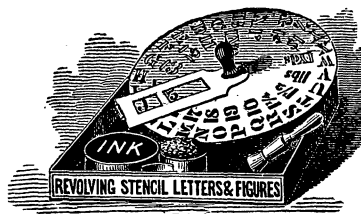
Press Cloths. The first one is put on inside the "heavy cap" or "press cloth," before the curd is put into the hoop, and the other one is put in when the cheese is "dressed." The cheese cloth circle does not go on under the bandage, where it is turned down on the end, but over it. In using the circles, there is no need of cheese grease till the cheese are shipped. The circle is then pulled off and the rind greased.

The circle makes the cheese much cleaner, and buyers generally prefer them, and will pay more money for the cheese, usually an eighth of a cent a pound more. The cost is about one-sixteenth of a cent a pound on flats. Sometimes by special agreement buyers want the circles left on the cheese.

They should be but twelve or thirteen inches in diameter, as they sometimes do not stick under the edge where they lap over the bandage.

Keep a Daily Record. When the cheese is ready

to ship, it quite often happens that a maker finds



something peculiar about a cheese, which he wishes to avoid or reproduce in the future, but he does not remember the circumstances connected with the

making of that particular cheese. In the best Canadian factories, a daily record is kept, in a book for the purpose, of how the milk and curd act. This gives them a history of each cheese, and by its aid, they have often been able to remedy defects, and reproduce the better points.

Such a record is kept of all cheese made at the Wisconsin Dairy School, only for greater convenience in the school the records are made by filling out printed blanks.

The following is a copy of one of the blanks:—

Date 189

Vat used (Number of vat),
 Condition of milk,
 Per cent. of fat in milk,
 Pounds of milk in vat,
 Rennet test for ripeness,
 Temperature set,
 Time set,
 Amount of rennet used,
 Rate of rennet per 1,000 lbs of milk,
 Time cut,

Minutes in curdling,
Time steam was turned on,
Time required in raising to degrees,
Hot iron test when dipped,
Time dipped,
Time from cutting to dipping,
Per cent. of fat in whey,
Time ground,
Hot iron test when ground,
Time salted,
Amount of salt on curd,
Rate of salt per 1,000 lbs of milk,
Time put to press,
Kind and number of cheese made,
Time dressed,
Time pressed,
Weight of green cheese,
Average weight of milk per pound of cheese,
Highest and lowest temperature of curing room for
last twenty-four hours,
Remarks:—

Under the head of remarks, any important thing not included under the other heads may be noted, such as a gassy curd, or washing out the bad flavor, or any way of treatment differing from the ordinary way.

J. H. Monrad has prepared a blank book for such records. It can be ordered for one dollar from Chr. Hansen's Laboratory, Little Falls, N. Y. Mr. Monrad has also published "A, B, C of Cheese Making," price 50 cents, and "Dairy Messenger," a complete treatise on butter making. Price \$1.25. Address J. H. Monrad, Winnetka, Ill.

CHAPTER XI.

CURING OF THE CHEESE.

Proper Temperature. The curing of cheese is a process of fermentation, whereby the insoluble curd is converted into soluble peptones. Cheese is cured best at a temperature of 60° F., for, as has been stated before, at this temperature the gases have a chance to diffuse and pass from the cheese, without injuring its texture, and the fat does not run out.

The curing room must, therefore, be so constructed that the temperature may be kept constant at 60°. Cheese also needs plenty of fresh air, to make it cure properly and produce a good flavor. If a batch of cheese is divided into two lots, and one lot boxed up, while the other is placed on the shelves, it will be found that the lot in the boxes will cure slower, and be inferior in flavor to the lot on the shelves.

Oxygen Needed. Dr. Babcock, in some work on the curing of cheese (published in First Annual Report of Cornell University Experiment Station), illustrated this still more fully, by curing cheese under bell-jars.

One cheese was fed pure oxygen, while the other was fed carbon dioxide (carbonic acid gas). The one receiving oxygen cured very rapidly and was fine flavored, while the one receiving carbon dioxide did not cure; and we thus see that fresh-air is essential for the proper curing.

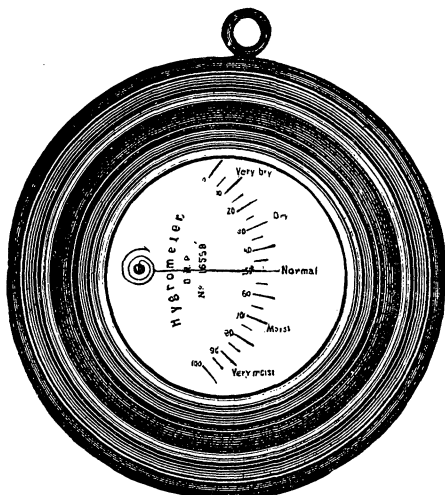
Curing Shelves, how Made. The cheese should be cured on shelves made of good clear pine, an inch and a half thick by sixteen inches wide, supported every four feet. The point in having the lumber clear is that sap and pitch will be in the knots and color the rinds. The boards should be wider than the cheese, for if the cheese projects over the edge, a mark will be left on the face of the cheese. The board ought to be heavy, and the supports close together in order to prevent sagging, which might make the cheese especially cheddars, crooked. The cheese should be turned every day, and the shelves wiped with a *clean* cloth. Pains should be taken not to soil the cheese nor break the corners in turning them.

Arrangement of Cheese. The older cheese should be kept on the lower shelves, and the younger ones on the upper shelves, because of the difference in temperature between the upper and lower portions of the room. The upper shelves being warmer, the younger will cure faster, and the month's make of cheese will be evenner than if this rule were not followed.

Cheese ought to be kept till they are a month old before shipping. There is so much indigestible green cheese put on the market, that people get disgusted with it. If they could always get cheese such as they like, they would buy more, and if more cheese was bought, the price would be higher, and the farmer would receive a good rate of interest for waiting for his money.

Moisture in the Curing Room. A matter that has not received its proper attention with American or

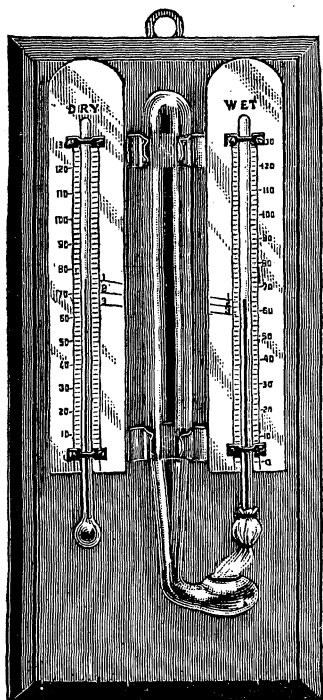
cheddar cheese is the humidity of the air in the curing room. There are two instruments for measuring the humidity—the hygroscope and psychrometer.



HYGROMETER OR HYGROSCOPE.

The Hygroscope. The hygroscope is an instrument consisting of a coil of material very sensitive to moisture. As it takes up or gives off water to the atmosphere the coil moves a hand around a dial which shows the per cent. of saturation.

The Psychrometer. The psychrometer consists of two accurate thermometers. On the bulb of one is a wick which dips in a cup of distilled water. When the air is saturated it has all the water it will hold. If the air is not saturated water will evaporate from the wick and the dryer the air the greater the evaporation. As the water passes from around the bulb into



PSYCHROMETER.

the air its lowers the temperature. The United States Weather Bureau has prepared a table of readings with the corresponding humidity. The following is such a table for use in a curing room.

The thermometer should be fanned briskly with a good fan for three minutes and then the reading taken quickly. We first find the dry bulb reading on the chart and then find the wet bulb reading in the next column, and in the third column opposite the dry bulb

reading is the relative humidity, or per cent. of saturation, by which we mean the per cent. of water the air is capable of holding at that temperature.

The psychrometer is not as handy as the hygrometer but is considered to be more reliable.

Table Showing the Relative Humidity in the Air of Curing Rooms. (KING.)

DIRECTIONS.—Notice that the table is in three column sections. Find air temperature in first column, then find wet bulb temperature in second column, same division. In third column opposite this is relative humidity.

Example.—Air temperature is 50°, in first column; wet bulb is 44°, in second column, same division. Opposite 44° is 61, which is the per cent. of saturation, or the relative humidity of the air.

Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.
40	32	37	43	34	34	45	44	92	48	41	53
	33	44		35	41					42	60
	34	52		36	48		35	26		43	66
	35	59		37	55		36	32		44	73
	36	68		38	62		37	38		45	79
	37	76		39	70		38	45		46	86
	38	84		40	77		39	51		47	93
	39	92		41	85		40	58			
41			44	42	92	46	41	65	49	38	30
	32	31					42	72		39	36
	33	38		34	29		43	79		40	42
	34	46		35	36		44	85		41	48
	35	53		36	43		45	93		42	54
	36	60		37	49					43	60
	37	68		38	56		36	28		44	67
	38	76		39	63		37	34		45	73
42	39	84	45	40	70	47	38	40	50	46	80
	40	92		41	78		39	46		47	86
				42	85		40	52		48	93
	33	33		43	92		41	59			
	34	40					42	66		39	32
	35	47		35	31		43	72		40	37
	36	54		36	37		44	79		41	43
	37	61		37	44		45	86		42	49
43	38	69	48	38	50	48	46	93	50	43	55
	39	77		39	57					44	61
	40	84		40	64		37	29		45	67
	41	92		41	71		38	35		46	74
				42	78		39	41		47	80
	33	28		43	85		40	47		48	87

Humidity in the Air of Curing Room.—*Continued.*

Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.
50	49	93		44	42		49	55		54	68
	40	33		45	48		50	61		55	73
	41	39		46	53		51	66		56	78
	42	45		47	59		52	71		57	84
	43	50	54	48	64	57	53	77	60	58	89
	44	56		49	70		54	83		59	94
	45	62		50	76		55	88			
51	46	68		51	82		56	94		49	40
	47	74		52	88					50	44
	48	81		53	94		46	37		51	49
	49	87					47	42		52	54
	50	93		43	33		48	46		53	58
				44	38		49	51	61	54	63
				45	43		50	56	61	55	68
	41	35		46	49	58	51	61		56	73
	42	40		47	54		52	67		57	78
	43	46		48	59		53	72		58	84
	44	51	55	49	65		54	78		59	89
	45	57		50	70		55	83		60	94
52	46	63		51	76		56	89			
	47	69		52	82		57	94		50	41
	48	75		53	88					51	45
	49	81		54	94		47	38		52	50
	50	87					48	43		53	54
	51	94		44	34		49	47		54	59
				45	39		50	52	62	55	64
	41	31		46	44	59	51	57		56	69
	42	36		47	50		52	62		57	74
	43	41		48	55		53	67		58	79
	44	47	56	49	60		54	72		59	84
	45	52		50	65		55	78		60	89
	46	58		51	71		56	83		61	95
53	47	63		52	77		57	89			
	48	69		53	82		58	94		51	42
	49	75		54	88					52	46
	50	81		55	94		48	39		53	51
	51	87					49	44	63	54	55
	52	94		45	36	60	50	48		55	60
				46	40		51	53		56	64
54	42	32	57	47	45		52	58		57	69
	43	37		48	50		53	63		58	74

Humidity in the Air of Curing Rooms.—*Continued.*

Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.
63	59	79	66	63	85	69	65	81	72	67	77
	60	84		64	90		66	86		68	82
	61	89		65	95		67	90		69	86
	62	95					68	95		70	91
64			67	54	41	70			73	71	95
	52	43		55	45		57	44			
	53	47		56	49		58	48		60	46
	54	51		57	53		59	52		61	50
	55	56		58	58		60	55		62	53
	56	60		59	62		61	60		63	57
	57	65		60	66		62	64		64	61
	58	70		61	71		63	68		65	65
	59	74		62	76		64	72		66	69
	60	79		63	80		65	77		67	73
	61	85		64	85		66	81		68	78
	62	90		65	90		67	86		69	82
	63	95		66	95		68	90		70	86
65			68			71	69	95	74	71	91
	53	44		55	42					72	95
	54	48		56	46		58	45			
	55	52		57	50		59	48		61	47
	56	56		58	54		60	52		62	50
	57	61		59	58		61	56		63	54
	58	65		60	63		62	60		64	58
	59	70		61	67		63	64		65	62
	60	75		62	71		64	68		66	66
	61	80		63	76		65	72		67	70
	62	85		64	81		66	77		68	74
	63	90		65	85		67	81		69	78
	64	95		66	90		68	86		70	82
66			69	67	95	72	69	91	75	71	86
	53	40					70	95		72	91
	54	45		56	43					73	95
	55	49		57	47		59	45			
	56	53		58	51		60	49		62	47
	57	57		59	55		61	53		63	51
	58	61		60	59		62	57		64	55
	59	66		61	63		63	61		65	58
	60	71		62	67		64	65		66	62
	61	75		63	72		65	69		67	66
	62	80		64	76		66	73		68	70

Humidity in the Air of Curing Rooms.—Continued.

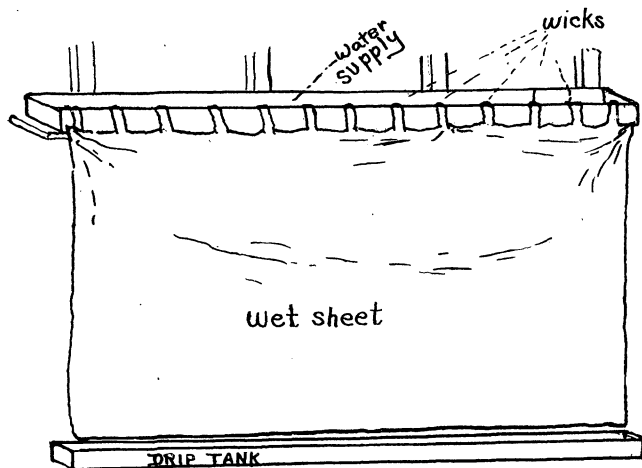
Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.
75	69	74	76	75	95	78	68	60	79	75	83
	70	78					69	63		76	87
	71	82		64	49		70	67		77	91
	72	87		65	52		71	71			
	73	91		66	56		72	75		66	47
	74	95		67	60		73	79		67	51
				68	63		74	83		68	54
76	63	48	77	69	67	79	75	87	80	69	57
	64	52		70	71		76	91		70	61
	65	55		71	74					71	64
	66	59		72	78		66	50		72	68
	67	63		73	83		67	53		73	72
	68	66		74	87		68	57		74	75
	69	70		75	91		69	60		75	79
	70	74		76	95		70	64		76	83
	71	78					71	68		77	87
	72	82		65	49		72	71		78	92
	73	87		66	53		73	75			
	74	91		67	56		74	79			

Condition of the Curing Room Air. The air should have as much moisture in it as it will hold without moulding the cheese. Cheese will stand a good deal if the air is kept moving, perhaps as high as ninety per cent. If kept between sixty and seventy per cent. it is very fair, but the instruments show that it often gets down to twenty or thirty per cent., and the cheese dry out rapidly and crack.

Supplying Moisture. Moisture can be supplied by sprinkling the floor, or better still, by hanging up wet sheets that are constantly supplied with water.

To supply a curing room of five thousand cubic feet capacity at least three cloths thirty inches wide by twelve feet long are needed.

They can be supplied with water from large trays into which numerous wicks from the top of the cloth run. The wicks should be three inches wide and six inches apart. The sheet should be made of heavy factory cotton cloth. The trays should be twelve inches wide, three inches deep and the length of the cloth or twelve feet; or for convenience, there might



be two trays six feet long. There should be a tray at the bottom of the cloth to catch the drip. This tray should be six inches wide and six deep. If there is plenty of running water a pipe with fine holes drilled on the under side might be arranged to hang the cloths on and water run through the pipe would keep the cloths saturated. A gutter at the bottom would carry off the surplus water.

After a while the cloths will get stiff from sediment from the water. They should then be boiled in water to which a little hydrochloric acid has been added. Do not use enough acid to injure the cloth.

CHAPTER XII.

SHIPPING THE CHEESE.

Cheese, How Boxed. Young Americas are shipped four, cheddars one, and flats generally two, in a box.

Where flats are shipped two in a box, they are placed one on top of the other, and are in that case termed "twins." When shipped one in a box, they are called "singles."

Scale Boards. That the rinds of the cheese may be well protected, "scale boards," or very thin basswood or whitewood boards, are placed in the box. Two or three are placed on each end of the box, and two or three between twins. This number is more than is generally used, but cheese in this way keep better when placed in cold storage. If flats are put together without scale boards, and left for any great length of time, they will stick together so tight that they can with difficulty be pulled apart. The rinds sweat and are easily broken. They therefore need plenty of scale boards. The boxes should be trimmed to one-eighth of an inch less than the height of the cheese, so that it will hold its place and arrive in market in good condition. They should not be more than a quarter of an inch larger in diameter than the cheese; if there is too much room in the box, the cheese will be likely to roll around and break the box. On the other hand, the box should not be so tight, that the cheese will stick in it.

Boxes that are split or poorly nailed should be thrown aside, for they will be sure to arrive in the market in a dilapidated condition. Cheese makers do not realize, that boxes that may be in *fair* condition, may be entirely useless at the other end of the journey.

How Cheese are Weighed. In weighing cheese nothing but full pounds are counted. For instance, if the weight is $60\frac{3}{4}$ pounds, it is counted but 60, or if the beam barely rises at 61 pounds, it is counted but 60, for in course of transportation, it would likely lose weight, and be cut down, when it is in the hands of the buyer. In the large warehouses, where hundreds of boxes arrive in a single day, they can not stop to weigh every box, but weigh a few boxes, and if they fall short, the whole lot is docked accordingly. Such weighings are referred to an official weighmaster.

Marking of Weights. The weight should be stenciled, or plainly marked on the box (not the cover) next to the seam, where it can readily be found. A lead pencil hardly makes a sufficiently plain mark on a cheese box. The brand of the firm, to whom the cheese is shipped, should be stenciled on the side of the box.

Buyer's Stencil. The buyer generally furnishes a stencil for this purpose. Each stencil, so issued to a shipper, has a distinguishing number on it, which is recorded in the buyer's office, and by referring to the number they can tell who shipped the cheese. This is especially necessary, where several factories make up a car load of cheese for a firm.

If a cheese-maker has any cheese that is not first-class, he should put a distinguishing mark on such and notify the buyer to that effect, and the buyer will usually deal fairly with him, for he understands that the maker is not trying to take advantage of him.

How to Sell Cheese. Cheese is sold mostly on the dairy boards of trade. The buyer, after he bargains for the cheese, should be required to inspect the cheese at the factory and accept or reject it. He should then give a draft on a local bank for the amount. The bank then draws on the firm for the amount, at the place of business of the firm and the cheese belongs to the bank till the draft is honored. This is a strictly cash basis, and is fair to both parties. When the cheese is hauled to the depot, the boxes should be covered with blankets, to protect it from the dust and the hot rays of the sun.

Branding Law. All parts of the old branding law not conflicting with the law of 1895 are in force, but it amounts to nothing as the branding is optional with the maker.

Laws of Wisconsin, 1895, relating to the Adulteration of Cheese and the Coloring of Oleomargarine.

No. 143 S.]

[Published March 14, 1895.]

CHAPTER 30.

AN ACT for the protection of the public health, and to prevent adulteration, deception or fraud in the manufacture and sale of dairy products.

The people of the state of Wisconsin, represented in senate and assembly, do enact as follows:

SECTION 1. No person, by himself or by his agents or servants, shall manufacture or shall buy, sell, offer, ship, consign, expose or have in

his possession for sale any cheese manufactured from or by the use of skimmed milk to which there has been added any fat which is foreign to such milk.

SECTION 2. No person, by himself or by his agents or servants, shall manufacture or shall buy, sell, offer, ship, consign, expose or have in his possession for sale, within this state, any skimmed milk cheese, or cheese manufactured from milk from which any of the fat originally contained therein has been removed, except such cheese is ten inches in diameter and nine inches in height.

SECTION 3. No person, by himself or by his agents or servants, shall render or manufacture, sell, ship, consign, offer for sale, expose for sale, or have in his possession with intent to sell, any article, product or compound made wholly or partly out of any fat, oil or oleaginous substance or compound thereof, not produced from unadulterated milk or cream from the same, and without the admixture or addition of any fat foreign to said milk or cream, which shall be in imitation of yellow butter produced from pure unadulterated milk or cream of the same, with or without coloring matter; provided, that nothing in this act shall be construed to prohibit the manufacture or sale of oleomargarine in a separate and distinct form and in such manner as will advise the consumer of its real character free from coloration or ingredient that causes it to look like butter.

SECTION 4. It shall be unlawful for any person to sell or offer for sale to any person who asks, sends or inquires for butter, any oleomargarine, butterine or any substance made in imitation of or semblance of pure butter not made entirely from the milk of cows, with or without coloring matter.

SECTION 5. It shall be unlawful for any person to expose for sale oleomargarine, butterine, or any similar substance not marked and distinguished on the outside of each tub, package or parcel thereof by a placard with the word "oleomargarine," and not having also upon every open tub, package or parcel thereof a placard with the word "oleomargarine," such placard in each case to be printed in plain, uncondensed gothic letters not less than one inch long, and such placard shall not contain any other words thereon.

SECTION 6. It shall be the duty of every person who sells oleomargarine, butterine, or any similar substance, from any dwelling, store, office or public mart, to have conspicuously posted thereon the placard or sign, in letters not less than four inches in length, "oleomargarine sold here," or "butterine sold here." Such placard shall be

approved by the dairy and food commissioner of the state of Wisconsin.

SECTION 7. It shall be unlawful for any person to peddle, sell or deliver from any cart, wagon or other vehicle, upon the public streets or ways, oleomargarine, butterine, or any similar substance, not having on the outside of both sides of said cart, wagon or other vehicle the placard in uncondensed gothic letters, not less than three inches in length, "licensed to sell oleomargarine."

SECTION 8. It shall be unlawful for any person to furnish, or cause to be furnished in any hotel, boarding house, restaurant, or at any lunch counter, oleomargarine, butterine, or any similar substance to any guest or patron of said hotel, boarding house, restaurant or lunch counter, without first notifying such guest or patron that the substance so furnished is not butter.

SECTION 9. Any person who shall violate any of the provisions of this act shall be guilty of a misdemeanor, and upon conviction thereof shall be punished for the first offense by a fine of not less than fifty dollars nor more than five hundred dollars; and upon conviction of any subsequent offense, shall be punished by a fine of not less than one hundred dollars or more than five hundred dollars, or by imprisonment in the county jail of not less than ten days nor more than sixty days, or by both such fine and imprisonment, at the discretion of the court.

SECTION 10. It shall be the duty of the district attorney in any county of the state, when called upon by the dairy and food commissioner of this state, or any of his assistants, to render any legal assistance in his power to execute, and to prosecute the cases arising under the provisions of this act; and the dairy and food commissioner shall have power to appoint, with the approval of the governor, special counsel to prosecute or to assist in the prosecution of any case arising under the provisions of this act.

SECTION 11. All acts and parts of acts inconsistent or conflicting with this act are hereby repealed.

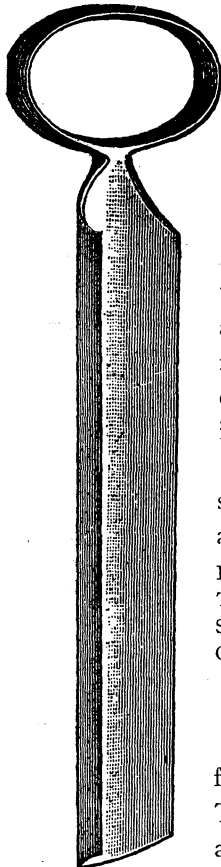
SECTION 12. This act shall take effect and be in force from and after its passage and publication.

Approved March 12, 1895.

6—C. C. M.

CHAPTER XIII.

JUDGING CHEESE.



CHEESE TRYER.

Ideal Cheese. One trouble that cheese makers meet with is, that they do not have the proper idea of a perfect cheese in their minds. This arises largely from the circumstances under which they are placed. The cheese are shipped out of the factory as soon as the buyer will take them, the youngest being but a week or ten days old. The cheese may have defects, but the maker does not get a chance to see how it will turn out.

Cheese exhibited at the Wisconsin Dairymen's Conventions is scored according to the following scale:

Flavor.....	50
Texture.....	30
Salt	10
Color.....	10
<hr/>	
Total	100

To try a cheese a plug is pulled from it by means of a cheese trier. The trier should be thin, round, and a little tapering, so that it will pull a round smooth plug. A plug

should always be taken from the top of the cheese. Never plug it through the bandage.

Flavor. Flavor is the most important item in the quality of a cheese. No matter how good the other points may be, if the flavor is bad, the cheese will be condemned. It would be a difficult matter to describe accurately just what the flavor should be like, for there are different flavors in cheese, which may be equally good. This comes about from the different ferments in the cheese which we cannot as yet entirely control. In another five years, bacteriological research will probably overcome this difficulty for us.

The old saying that "the proof of the pudding is in the eating of it," is true of cheese. If it tastes good and we want more of it, it is just the flavor we should have. It should not be sharp so that it will bite the tongue, but of a mild lasting taste. A great many cheese, in which the flavor cannot be termed bad, are still on the negative side; they do not have that fine lasting aroma, although we can eat them quite agreeably, but do not feel that it is a matter of very great importance, whether we can have more of the same or not.

Where experts are judging cheese, they seldom taste of any. They get the flavor simply by the smell, for if they tasted of every plug they would soon be confused as to flavor.

If a cheese is cold, it should first be warmed up in the fingers, before looking for the flavor.

Texture. While flavor stands first in importance, the texture of a cheese comes next. The plug should

be smooth, not fuzzy. If the cheese is not fully cured the plug should bend a little before breaking. When held between the eye and the light it should be slightly translucent. If the light does not come through it, it is a sign that the texture has been injured in the manufacture, probably by too high acid. When a piece is broken from the plug, it should not crumble off, but should show a surface such as flint does when broken, and is therefore termed a "flinty break." When pressed between the fingers it should not stick to them but should mould like wax. Cheese that is tough and will not come down readily between the fingers, is said to be "corky," and is probably due to over cooking or insufficient quantity of rennet to cure it properly. Cheese should not be mealy, as is the case with high acid or too highly salted cheese.

A cheese with good texture should not have any round, smooth or ragged holes in it; but should be as solid as a board.

Cheese with the round holes, or one that is soft and pasty, will go off flavor on further keeping.

Salt. As was said under the subject of salting the curd, salt gives flavor to a cheese. In fact, the whole subject of flavor is affected by the salt. Cheese that are a little soft and a little inferior in flavor could have been entirely remedied by using a little more salt. It has also been stated that salt may injure both the texture and flavor by using too much. The influence of salt is, therefore, partly considered under texture and flavor.

Color. Like salt, the color of a cheese really is

another way of judging its texture and flavor. A cheese without any coloring matter added to it is improperly termed "white." An uncolored cheese should never be white, but of a light *amber* color. If it is a dead white, it is so because the acid has cut the color out of it. Of course in a colored cheese, these things would be more easily seen.

The color should be even from one end of the plug to the other. A high acid cheese will give a distinct order to the trier, the same as when acid attacks steel.

In judging cheese unless some particular market is in view, the shade of color cannot be taken into consideration. New Orleans requires a very high color, St. Louis less, and Chicago still less, while Boston in this country, and Bristol in England, want no artificial coloring. The tendency toward making uncolored show cheese seems to be increasing.

Gross Appearance. A good judge can usually tell the quality of a cheese from the outside appearance. It should be square, and the rind without cracks, for cracks indicate high acid. When the fingers are run over the surface, it should be springy, that is, it should give readily under the pressure and regain its position. If the finger sinks into a place which does not spring back, it indicates a hole or soft place in the cheese. The rind should not have any white spots on it, as these indicate whey. Sometimes the white spots will disappear in time, but it is a weak point in the quality of the cheese. When the plug has been replaced in the cheese, the place should be greased over, to keep the cheese from drying out, and skippers from getting into the same.

Wisconsin Factory Cheese Makers' Scale. The scale adopted by the Wisconsin Factory Cheese Makers' Association at Fond du Lac, 1895, is an improvement over the old one. It is as follows:

Flavor	45
Texture.....	30
Color.....	10
Make up and general appearance.....	15
Total	100

In this the salt is judged in flavor and texture where it belongs, while the very important item of the neat way in which the cheese is put up gets proper consideration. Under the old scale a dirty, poorly bandaged, crooked cheese, might get as high a score as a neat square one.

The English scale of points:

Flavor.....	35
Quality	25
Texture.....	15
Color	15
Make	10
Total	100

In the above English scale quality, that considers that the cheese should be mellow, rich, melting on the tongue, applies to an old, well cured cheese. The cheese that goes onto the market in this country would not do that.

Public Needs Educating. Our people do not know what good cheese is, because the great majority of them never get any fully cured. If they could get well cured cheese they would soon get accustomed to it and would eat six times as much and none of the

new green cheese. Of course if we were to suddenly put a lot of old cheese onto the market they would not know how to take it, but we should give them a little and they will get used to it and want more. The public needs educating as to what good cheese is.

PART II.

Hints on the Construction and Operation of Cheese Factories.

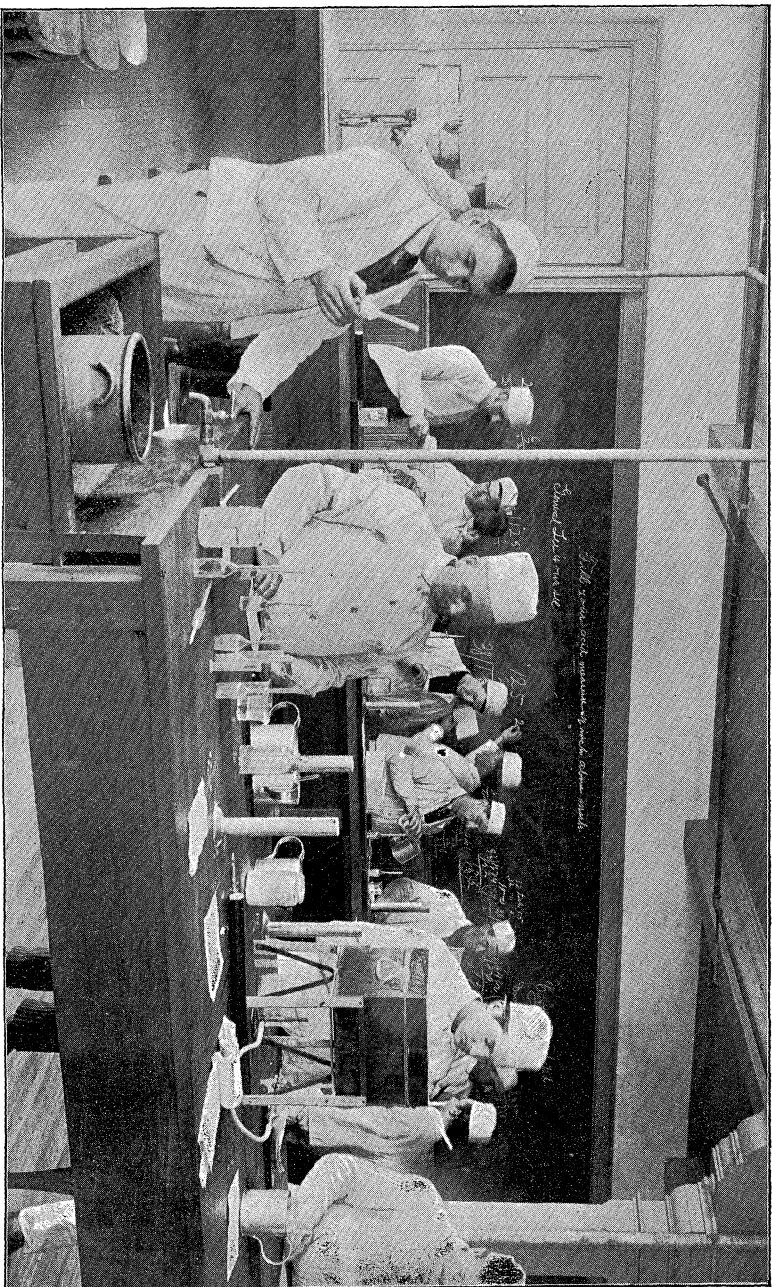
CHAPTER I.

CONSTRUCTION OF FACTORIES.

One Difficulty in Making Good Cheese. A large part of the difficulty experienced in the making of good cheese, results from the condition of the factories. In order that we may overcome these difficulties, let us look at the factories and see where they are wrong in their construction, and then we will be in a position to suggest a remedy.

Too Many Small Factories. In the first place, there are too many small factories in which little milk is received, and in which too low a price for making is charged, and therefore the owners cannot afford to build properly equipped factories. In the older cheese manufacturing districts the tendency has been to build a little shanty on every cross-road; people are beginning to see the folly of this, however, and I believe the tide is turning toward larger and better equipped factories.

Poor Buildings. A great many of the buildings are little more than one thickness of boards. The vat room is small, and in hot weather the temperature of the curing room cannot be held down to the proper



STUDENTS TESTING MILK—WISCONSIN DAIRY SCHOOL.

point, while in cold weather, both the vat and curing rooms get down nearly to the freezing point; in fact the cheese may freeze in the hoops.

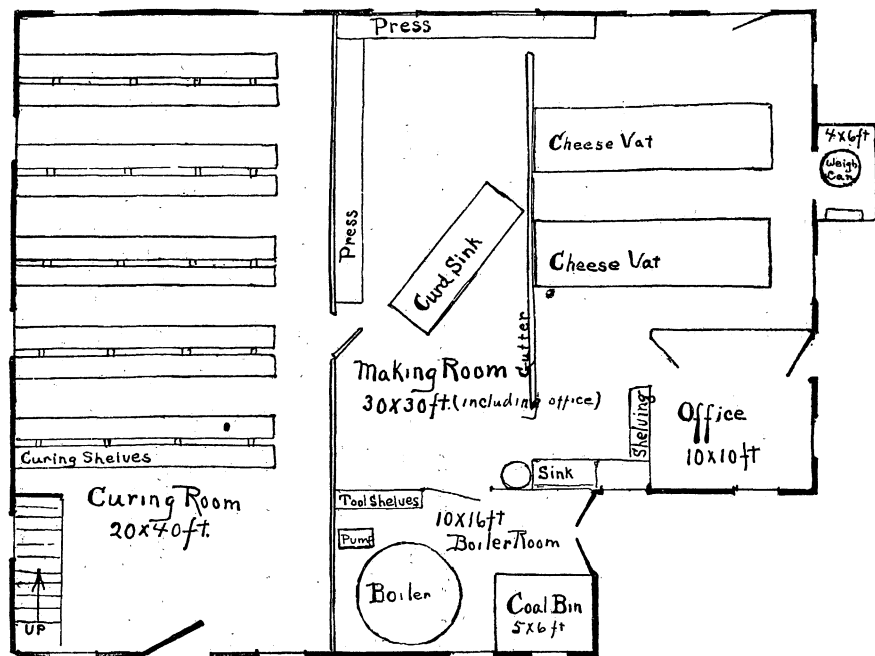
Poor Foundations. The floors are light and poorly supported. Whey is run onto the floor, and leaking through, forms a bad mud hole under the factory on account of imperfect drainage.

Whey Tank. The whey tank is set down in the ground where it cannot be cleaned out, and it is allowed to rot week after week, and contaminate the milk cans in which the whey is returned to the farms. It has even happened that horses have been scared, and run away on account of the smell around a factory!

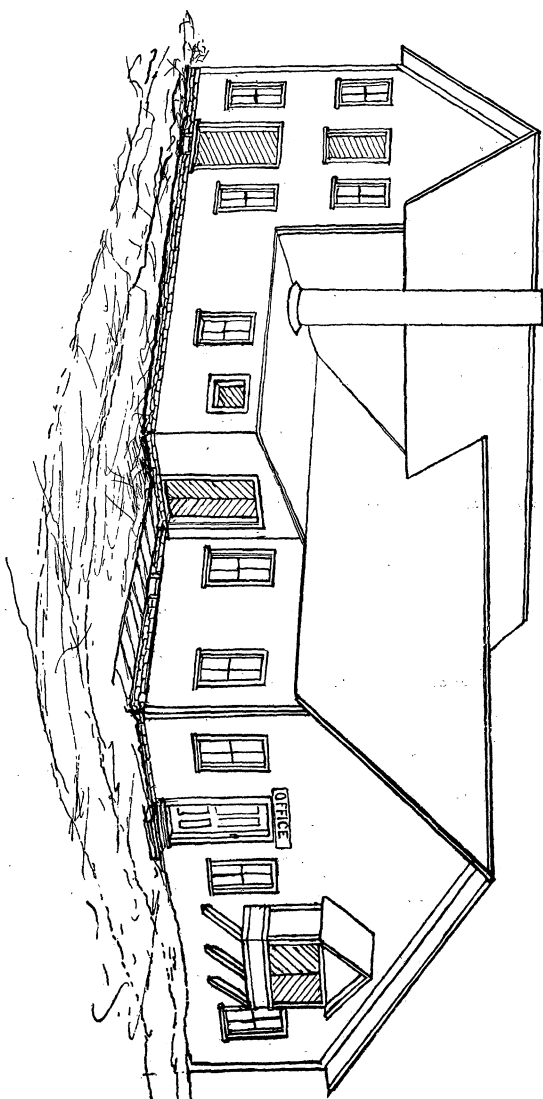
No Hot Water. In many factories there is no steam, but the milk is worked up in self-heating vats, and there is never water hot enough to scald out utensils, or even melt the grease off from them. Nor is there a sink for washing tools, and clean wash rags and towels are often lacking.

Any one who knows about our factories would, I think, say, that probably one-half of them, would answer to this description. A great many persons do not like to admit that it is so, but we should never turn away from the truth, even if it does look dark, for unless we know the true condition, we cannot have a proper basis for improvement.

It is for this purpose that we have drawn this picture, that we may know how to remedy our mistakes. We will therefore consider how a factory may be properly built and equipped.



GROUND PLAN FOR CHEESE FACTORY.



ELEVATION OF CHEESE FACTORY.

We will equip the factory for ten thousand pounds of milk per day, which I think is small enough.

Ontario Cheese Factories. One secret of Western Ontario's success is in the fact that her factories are large, well built, and properly equipped.

On pages 90 and 91 we give the plans for a factory.

Good Foundations. In the first place, we should get good solid foundations, either of stone piers, or gas pipe, which allows the ground to heave and settle, without raising or lowering the building. The supports should be close enough together to hold the sills in place.

Dimensions. Our plans call for a making room 20 x 30 feet, with an office ten feet square taken out of one corner of it, and a boiler room 10 x 16 feet attached, and a curing house 20 x 40 feet, two stories high.

Store Room. The upper story should never be used for curing cheese, but for storing cheese boxes and other supplies.

Curing Room. Some Canadian factories have the curing house separate from the rest of the factory, but we can build them together and save the lumber for a second wall, which would be necessary if they were separated.

Sills. We should have 8 x 12 inch sills around the outside of both parts of the building. There should be two 6 x 8 inch stringers, running across the make-room, and one of the same dimensions running through the middle of the long way of the curing-room. Ten

foot joists can be put between the sills and stringers. The dimensions of these joists should be 2 x 10 inches, and they can be placed eighteen inches apart.

Curing-Room Floor. The joists under the curing room should have rough boards nailed close together on the under side, and a five inch layer of tan bark put in between them. There will then be a five-inch space left above the tan-bark, over which a tight, heavy floor, is to be laid. This may be made, by first laying rough boards, and covering with paper, and then laying the regular flooring. The tan-bark, air space, and tight floor, are to protect from outside temperature.

Vat-Room Floor. The making room should have a heavy two-inch floor, preferably of maple. It must slope at a scale of one inch in five feet, toward a ditch at the lower end of the vats or twenty feet from the front end of the room.

Curing-Room Walls. Paper can be put on the studding under the siding, and the walls lathed and plastered. The studding is of 2 x 4, such as is generally used, and if tan-bark can be easily obtained, it can be filled in between the studding. Tan-bark is better than saw-dust for filling in such places, as mice are not inclined to work in it as much. It is hardly necessary to say, that the top of the room should either be ceiled or plastered.

The curing room must practically be a large box, with walls so constructed, that the temperature inside will be affected as little as possible by the tempera-

ture outside; some means of introducing cool, fresh air into the curing room is highly desirable.

The walls and ceilings will therefore have to be of several thicknesses, with air spaces between, like the floor which we have already described.

Doors and Windows. We must not forget, after we have built such walls, to have the windows fit tight and have shutters on the outside. The doors must be heavy, with air spaces in them, and close tight with a lever latch like a refrigerator door.

To construct our walls, we may put up our 2 x 4 studding two feet apart, which is to be lathed and plastered inside. On the outside, rough boards and paper may be put, and then another row of studding, and paper nailed on with boards on the outside of these. In the spaces in the outer row of studding, tan bark may be filled in.

Joists. The joists in the ceiling should be 2 x 6, ten feet long, eighteen inches apart, supported by 4 x 6 running crosswise of the room. If the room is ceiled overhead, tan-bark three inches deep can be filled in between the joists, and then a layer of paper put down before the floor is laid. If the room is lathed and plastered, boards must be put in to hold the tan-bark. The second story, which is used only as a store room, need not have double walls. A tight fitting trap door should be made between the store room above and the curing room below, through which to get the cheese boxes down.

Stone Cellar. A better wall for the curing room in first story may be made of stone, and built into the side

of a hill, for still greater protection from outside temperatures, as is the case with cellars for curing of brick and Swiss cheese. The stone and earth help to keep down the temperature of the air in the room.

Sub-Earth Ducts. But if a sub-earth duct be used, the first mentioned form of wall will be sufficient. A sub-earth duct is, as its name implies, an underground air duct. At about twelve feet below the surface, the ground maintains a constant temperature, of something like 50°F., and if we have a duct long enough, the air drawn through it will be cooled to near the temperature of the ground. Now if we have such a duct, say twenty inches in diameter and six hundred feet long, we can ventilate the room with cool fresh air. Without this duct, we would have to ventilate the room by opening the windows in the cool part of the day, and keeping them tightly closed when the air outside was too warm.

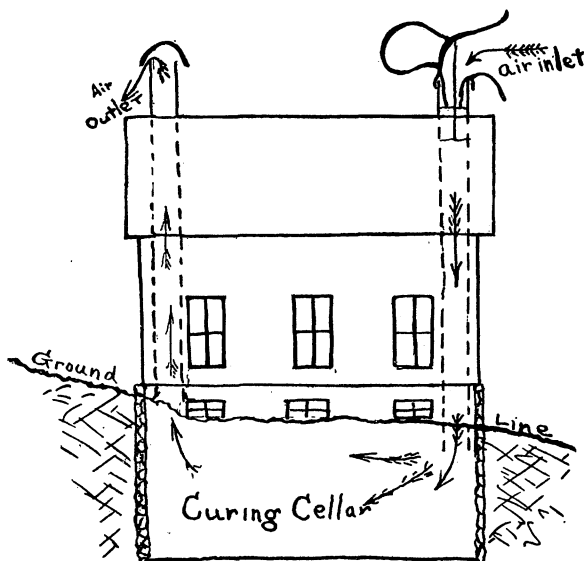
In order to start a current of air through an air duct, we must first build a fire in the chimney, and start a draft of warm air up the chimney. This will soon rarefy the air in the room, so that the air in the duct will start to fill up the space.

In Prince Edwards Island the Canadian government is putting up cheese factories for the people. The curing rooms are ventilated by sub-earth ducts. These ducts are made of planks nailed together and are three to five feet in the ground and three hundred feet or more long. While these ducts are not perfect they are cheap in construction and help greatly in keeping the temperature of the curing room down. Their cli-

mate is not quite as warm as in Wisconsin, hence three to five feet will do with them. A perfect duct will hold the temperature of a room at about 50°F.

Regulating the Air Supply. We can regulate the temperature by having a register over the duct, and admit the air as fast as we want it.

Tube, how Built. The tube, of course, might fill up by the water in the ground running into it, if the ground at both ends was higher than the other part, or it might run into the factory if that end were lower, but we can obviate all this difficulty by making it slope the other way.



Curing Cellars. In some places cellars made for curing brick cheese have been used with splendid re-

sults with cheddar cheese. Such a cellar is built into the side of a hill, is stoned up on the sides and rises above the ground just far enough for small windows around the top. One trouble with these cellars is that they are sometimes so damp that cheese will mould rapidly.

Cellar, How Ventilated. This can be obviated by ventilation. At each end of the room is an eight-inch pipe running up through the roof. One of these has a cone above it to prevent the rain coming in through it. On the top of the other is a hood with a tail that keeps the hood always facing toward the wind, and the wind striking into the hood carries a current of air down into the room, while another current of air goes out of the other pipe. Dampers similar to those put into stove pipes can be arranged in these pipes to regulate the flow of air. If the air should get too dry, moisture could be supplied by means of wet sheets. I have seen such curing cellars where the inside temperature did not go above sixty-five degrees while that outside was eighty-five to ninety. We would have to change the plans of the factory here given for such a curing cellar.

Boiler Room. The boiler room should have a cement floor laid on the ground, and it should be lined with corrugated sheet iron, to insure against fire.

Building should be Raised. The rest of the building should be raised about a foot above the ground, so that air may circulate beneath and keep the sills from rotting.


Water Supply. A good well is an absolute necessity for a cheese factory; water can be pumped into a galvanized iron cistern placed above the curing room. This cistern should be set in a drip pan, which will catch any leak or sweat from it, and carry it outside without leaking through into the curing room.

Hot Water. From the cistern, water may be carried in pipes to the different parts of the building. The water pipes should be galvanized. There can be a steam pipe running into the water pipe by a T, and the flowing water can be heated by turning steam into it.

Sewer. In connection with the factory, there should be what is forgotten in nearly every factory, namely, a proper sewerage system. There should be regular six-inch sewer pipe underground, leading to a stream or blind-well, to convey the slops from the building.

In locating a factory, farmers figure on the handiest place for them to haul their milk to, but usually do not at all consider the sewerage question.

Blind-Well. If there is no stream handy the blind-well may have to be used. A blind-well, as one would surmise from the name, is a covered hole, into which the slops are run and absorbed by the ground. Care should be taken not to locate too near the water well, as the slops will in such cases percolate through the soil to the water supply. The danger from this source is greater in cases of gravelly, loose soils. There should be an opening to the surface of the ground, for gases will be generated and force their way back through the sewer pipe.

Sewer Trap. At the mouth of the sewer there should be a sewer trap, which is simply an  shaped pipe, in which water constantly stands and keeps gas from coming up from the sewer.

Sewer in Clay Soils. In a clay soil the slops will not be absorbed fast enough, and the sewer pipe will, in that case, have to divide into a number of forks to spread the material over the surface, or near the surface of the ground. The slops should, in that case, be carried six hundred feet away from the factory.

Whey Tank, How Built. The whey tank should be lined with galvanized iron, and be placed high enough for a wagon to drive under, and draw off the whey by simply opening a valve. The ground ought to be paved in such a way that the drip will run off into the sewer.

Elevating Whey. To get the whey from the vat into the whey tank, it can be drawn into a box or barrel, and from there forced by a steam jet into the whey tank. The whey should be scalded to keep it sweet, and after the patrons have gone every morning, the tank should be scrubbed out and steam turned into it to scald it out. There should be a platform around the tank and steps leading up, so that a person can get into it easily.

Bath-room. One thing that a factory should have, though generally unthought of, is a bath-room. This can be placed above the curing room. A room, five by eight feet, can have a floor covered with galvanized iron, to catch any drip or slop, and a bath-tub put in. Hot and cold water can be connected with it, and a most desirable thing supplied.

CHAPTER II.

EQUIPMENT.

For a factory of the capacity we are building, we will need an eight horse power boiler. A horizontal brick arch boiler is preferable to a vertical one, as it will hold the heat better, and a person can more easily clean the flues.

There should be a good steam-pump, and possibly an engine, though that is not absolutely necessary. For ten thousand pounds of milk, we will need two vats of a capacity of 5,200 pounds; these ought to be provided with whey gates for emptying them.

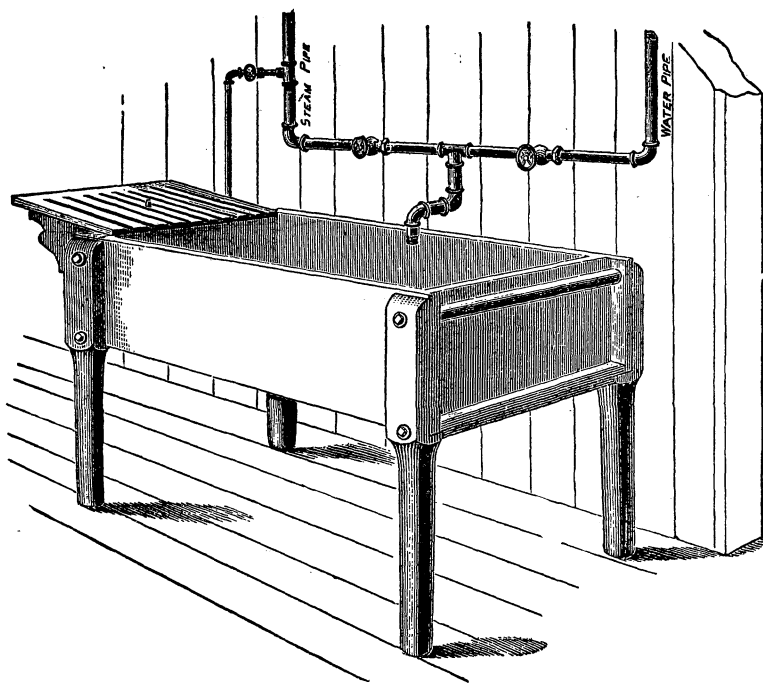
Water Boxes of Vats Should be Lined. It is quite essential also, to have the water boxes of the vats lined with galvanized iron, or they will leak, making a bad mess on the floor.

Curd Sink. It will be remembered that we said in Part I, that a curd sink was a necessary piece of apparatus in getting the curd drained properly; we must therefore have a curd sink constructed in the way suggested. (See page 42.)

For the curd from 10,000 pounds of milk, two gang presses, and either twenty cheddar or forty flat hoops will be required. We should not attempt, as is quite commonly done, to press two flats in a cheddar hoop by putting a divider between. We cannot make an artistic looking cheese in that way.

Pressing Flats. Flat hoops do not cost near as much as they did a few years ago, and the expense will be but slightly increased in providing the necessary number of hoops.

Sink, How Made. Another necessary thing, which is seldom found in a factory, is a good sink. It should



WASH SINK.

be iron or galvanized iron lined, and plenty large enough—say three feet long, by twenty inches wide, by twelve inches deep, properly connected with the sewer. At the end of the sink, should be a wide shelf or table inclined toward the sink, so that drip-

pings will run off into the sink. This shelf is used to drain tinware on, and a steam jet projecting through it, can be used to sterilize utensils.

We need hot and cold water connections at the sink, and perhaps a hot water barrel beside it. This barrel may be made of galvanized iron, and should be used for a supply of clean, hot water, *rather than a place to wash dirty tools*. This latter operation ought to be performed in the sink.

Milk, How Lifted. If the roadway is not high enough to empty the milk directly into the weigh-can, a large wheel fixed tight on an axle is probably the best appliance for lifting the milk. An endless rope runs over the wheel, and by pulling this rope the wheel turns and winds up another rope on the axle. This rope has tongs on it, which take hold of the milk can.

The weigh can is placed on an 800 lb. double beam scale, which stands in a receiving room or covered platform. This platform is built out on brackets in front of the factory. On one side of the room, is a shelf for the milk book, and another for the sample jars. The milk is run from the weigh can to the vat, through an open tin conductor.

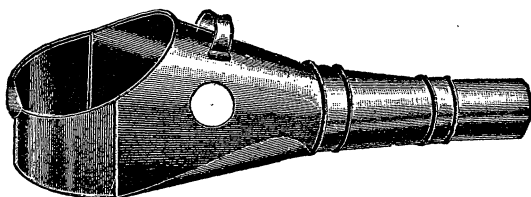
Milk Testing. For testing the milk, we should have a thirty-bottle, steam turbine, Babcock test, and a Quevenne lactometer. The Quevenne lactometer gives a direct reading of the specific gravity, and is used in connection with the Babcock fat test for detection of watered milk. The Babcock test is now used in most factories; and probably in one half of the factories, the milk is bought according to test.

That this is the only fair method of paying for milk, will be seen, for both the quantity and quality of the cheese made from the milk depend on its fat content.

Appliances Needed. We will name over some of the minor articles needed in the factory, for some of them are usually found lacking, and sometimes there are not enough of the articles, to enable one to work handily.

There ought to be two curd knives—horizontal and perpendicular—and they should be six or eight inches wide, and twenty inches long.

We need a rennet test, and *two or three* reliable thermometers, for these are easily broken, and we must not run the risk of being without one.



CONDUCTOR HEAD.

We also need a hair sieve, linen strainer cloth, wash-dish, two curd pails, three or four twelve-quart tin pails, several dippers, one of which has a flat side, and a perforated-tin bottom, for skimming specks off from the milk.

Curing Shelves. The shelves in the curing room are supported by cross pieces, attached to wooden posts. These posts are 4 x 4's, reaching from floor to ceiling. The cross pieces are 2 x 4's, set into the 4 x 4, to keep them from tilting, and a bolt put through

to hold them in place. The shelves are sixteen foot boards; sixteen inches wide, and one and a half inches thick. They should be the clearest pine lumber obtainable.

The shelving can run crosswise of the room, and if the boards are sixteen feet long, there will be a four foot passage on the side of the room next to the making room. At the further end of the room from the door to the making room, ten feet of space can be left for boxing cheese.

Cost of Factory. The factory we have suggested will cost more than the ordinary run of factories, for it is much better. Nothing that will be a waste of money, has been suggested. Certain firms put up factories which are inferior to this, for which they get a third more money than this would cost.

As the cost of material in different localities varies so much, we have not set a price on this factory, but the necessary facts are given, so that any one can figure on the cost of the building for his own locality, and then reliable firms will furnish machinery at reasonable prices.

CHAPTER III.

MILK TESTING.

When one stops to think that only ten years ago, or even less, the only means that a cheese maker had of determining the quality of milk was the crude test tube, where the milk was set for the cream to rise, and a lactometer that would read good milk when both skimmed and watered, he begins to realize what great progress has been made in milk testing in so short a time. This great change has been brought about by work done at the Agricultural Experiment Stations, and this one line of progress is paying large dividends on all the money that has been invested in them.

Paying by Test. People often get confused about the justice of paying for milk, at cheese factories, according to the test. They think four per cent. milk ought to make a third more cheese than three per cent. milk. They do not consider the question of quality. If their proposition were true, no cheese could be made from thin skim milk with no fat in it. The facts are, that about five pounds of cheese can be made from one hundred pounds of such skim milk, which can be sold with great difficulty, for one cent a pound, or five cents per hundred of milk, after going to the trouble of making the cheese. The milk is worth more than that for feeding purposes, before touching it for cheese, to say nothing of the cost of

making. Four per cent. milk will make ten pounds of cheese, that will sell for ten cents a pound, and one hundred pounds of four per cent. milk is worth one hundred cents. The skim milk made into cheese is worth five cents, or a difference of ninety-five cents for the fat. We have but five pounds more of cheese, but the difference in quality made by the fat is really the great difference.

Very careful and extensive work has been done to find the effect of fat on the value of milk for cheese.

Dr. Van Slyke took up the subject in New York at the Geneva Experiment Station and in a large number of cheese factories, and found that the yield of cheese was proportional to the fat content of the milk. Henry Walvoord of Cedar Grove, Wis., a Wisconsin Dairy School student, was the first person in the world to operate a factory on the test plan. His work for two seasons agrees almost exactly with Dr. Van Slyke's.

Prof. Dean, of the Ontario Agricultural College, carried on less extensive experiments, but did not find the increase in yield directly porportional to the fat.

Reports from Wisconsin Dairy School students representing forty million pounds of milk made into cheese, give very valuable information along this line, and Dr. Babcock has compiled the figures for an article in the Eleventh Annual Report of the Wisconsin Experiment Station. When these reports were arranged according to months, he found that the yield of cheese varied from 2.57 pounds to 2.70 pounds, or

an average of 2.63 pounds of cured cheese per pound of fat for the season.

TABLE I.

Yield of cheese in factories by months:

MONTH.	NUMBER OF REPORTS.	PER CENT. OF FAT.	YIELD OF CHEESE FROM 100 LBS. MILK.	CHEESE FOR ONE POUND OF FAT.
April	22	3.480	8.154	2.630
May	68	3.493	9.447	2.704
June	66	3.497	9.367	2.679
July	63	3.554	9.231	2.593
August	49	3.634	9.335	2.568
September	36	3.836	9.955	2.594
October	28	4.076	10.562	2.591
November	15	4.254	10.947	2.573
Season	347	3.640	9.566	2.628

These results were almost exactly the same as shown by Dr. Van Slyke's work. However, when these reports were grouped together according to per cent. of fat, a range in the quality of the milk from 3.13 per cent. to 4.45 per cent. was obtained, and a range in yield of from 2.41 lbs. for the poor to 2.94 pounds for the rich milk.

TABLE II.

Yield of cheese arranged according to the per cent. of fat in milk.

NUMBER OF REPORTS.	RANGE OF FAT IN PER CENT.	AVERAGE FAT PER CENT.	YIELD OF CHEESE PER 100 LBS. OF MILK.	POUNDS OF CHEESE FOR ONE POUND OF MILK.
24	Under 3.25	3.126	9.194	2.941
90	3.25-3.50	3.382	9.235	2.730
134	3.50-3.75	3.600	9.407	2.613
43	3.75-4.00	3.839	9.806	2.562
36	4.00-4.25	4.09	10.300	2.512
20	Over 4.25	4.447	10.707	2.407
347		3.640	9.566	2.628

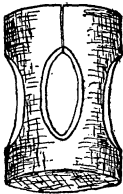
This is similar to what Prof. Dean found, and a person might infer from this that while the rich milk makes more cheese than poor milk, it is not more in proportion to the fat and therefore it cannot be fair to pay for milk in proportion to its fat content. But Dr. Babcock goes further and shows that while the richer milk does not make more cheese in proportion the fat goes into the cheese and makes it richer, and that the market reports put the value of cheese to be according to the fat it contains, and when figured back to the milk the money obtained for the cheese is more nearly directly proportional to the fat than to any other factor. That is, butter fat in milk is

NOTE. Dr. Van Slyke has published his work in a number of bulletins of the Geneva, N. Y., Experiment Station during 1893 and 1894. A good summary by him is given in the twenty-third annual report 1893 of the Wisconsin Dairymen's Association. Mr. Walvoord's work referred to is also there given.

worth a certain price per pound, and whether the milk contains three or four and a half per cent. fat the value of it for cheese is that price per pound of fat that it contains.

Composite Samples. The samples should be saved from each patron's milk every morning by stirring up the milk in the weigh can with a dipper. An ounce cup is then filled with the milk, and turned into the sample jar.

Milk Thief.



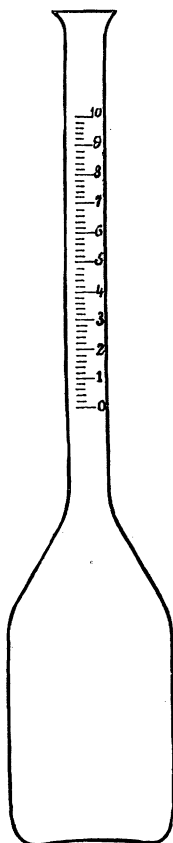
VALVE END OF SCOV-
VELL'S MILK THIEF
USED AT WORLD'S
FAIR.

A still better way is to take the sample with a milk thief, which is a long tube three-fourths of an inch in diameter, with a valve in the bottom. By lowering this into the weigh can a sample of the milk all the way down runs in at the bottom and the valve is closed by striking the bottom of the can. The tube is then drawn out and emptied through the upper end into the sample jar.

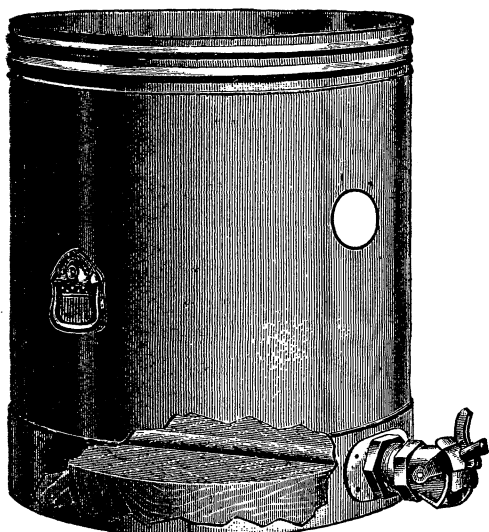
Sample Jars should be Marked to Prevent Mistakes. Each jar has the number of the patron marked on it with asphalt paint, or in some other substantial way.

Milk Samples. How Preserved. A small quantity of potassium bichromate, enough to color a jar of milk a bright yellow, is put into the jar, before any milk is put into it, and this chemical will preserve the milk for a week or more.

At the end of a week the composite sample of each patron's milk is tested, and the reading of the Babcock test is the percentage of fat in the whole of the week's milk.



TEST BOTTLE.



WEIGH CAN.

The Babcock Test. The Babcock test was invented by Dr. S. M. Babcock of the Wisconsin Agricultural Experiment Station, and published in Bulletin No. 24, July, 1890, and is now not only in general use in this country, but is also used in the different countries of Europe, and India, New Zealand and Australia. It has literally "gone round the world."

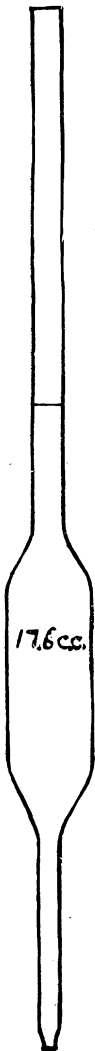
It consists of four parts:

The Bottle. A bottle holding about two ounces and having a long, narrow neck, about the size of a lead pencil. On this neck is a scale covering a volume of two cubic centimeters marked off into fifty divisions. Every five divisions marks one per cent. and each division is therefore two-tenths of one per cent.

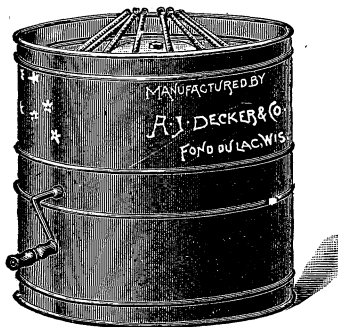
The Pipette. The pipette is a glass tube with a bulb in the middle for measuring the milk. There is a mark on the upper narrow stem indicating 17.6 c. c. which volume of average milk would weigh eighteen grams.

The Acid Measure. This is a glass cylinder with a 17.5 c. c. mark on it for measuring the sulphuric acid used in making the test.

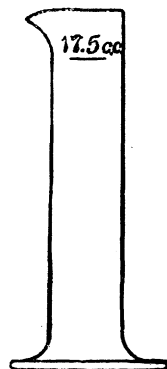
The Centrifuge. This a machine for whirling the bottles. It consists of a drum about



PIPETTE.



BABCOCK MILK TESTING MACHINE.



ACID MEASURE.

twenty inches in diameter with sockets on the circumference for holding the bottles. The drum is encased in a jacket and is driven by a crank or pulley and gear, or by a steam motor.

To make the Test. The milk to be tested must be thoroughly stirred to get the fat globules evenly distributed. This can be done by pouring from one vessel to another several times. If in the composite test the cream is somewhat hardened it can be dissolved by warming the milk a little, but this must be done with care as the milk will then churn easily. After the milk is thoroughly mixed draw it up into the pipette by suction with the mouth, and then quickly place the finger over the upper end of it. By letting air in slowly under the finger the milk will run out till it comes down to the 17.6 c. c. mark. Then deliver the contents into the bottle. Next measure 17.5 c. c. sulphuric acid into the bottle, and by a circular motion mix the acid and milk thoroughly till the milk is all dissolved, that is till no clots are left.

Then put the bottle in the centrifuge and whorl five minutes. At the end of this time the fat will all be on the top of the liquid. Hot water is filled in to bring the fat up into the neck where the amount can be read on the scale. It is whorled another minute to bring the fat all into the neck in a solid mass. It must be read before it gets cold or in a perfectly liquid condition. The bulletin describing the test says 140° F. Better results may be obtained by first filling to the neck and whorling, and then filling into the neck for the final whorling.

Several points of caution should be observed to get uniformly clear readings and reliable tests.

Strength of Acid. First the acid used should be commercial sulphuric acid of a specific gravity of 1.82 to 1.83. If too strong the fat will be charred and there will be black specks in the fat. If too weak, there will be either white curdy matter with the fat or a clear test and not all of the fat. Dairy supplyhouses now furnish a hydrometer for testing the specific gravity of the acid. If it is 1.81 it is too weak, and if over 1.83 too strong. If the acid is not too much too strong or too weak we can obviate the difficulty by using a little more or less as the case may require. One should observe the color of the fat. It ought to be a deep straw or yellow color. If white or light colored the acid is weak, if black it is too strong. As a general thing there is little difficulty in getting good acid.

Dr. Babcock has invented an automatic acid measure which will fill the bottles with the right amount directly from the acid bottle as fast as the bottles can be shaken. They should be shaken one at a time and not in a tray or in the machine together, as in that case the milk in some bottles is not thoroughly dissolved.

The acid should go to the bottom of the bottle without mixing with the milk till the final shaking. If it mixes partially and then is allowed to stand, part of milk will get the effect of the acid too strongly, will be charred, and appear in the fat as black specks.

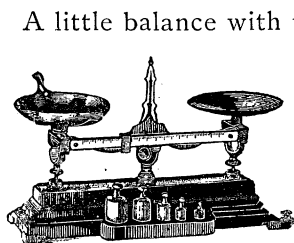
Speed of the Centrifuge. The speed of the ordinary tester, which is about eighteen inches in diameter,

should be about one thousand revolutions per minute. The fat is forced to the top of the liquid by the centrifugal pressure, and unless this pressure is sufficient all the fat will not be separated. If the speed is too great the bottles will fly to pieces. Dr. Babcock does not recommend a steam turbine test unless there is a speed indicator attached. A good many of these machines are supplied with steam gauges, but a steam gauge only indicates the pressure applied to the drum, and does not tell the speed.

Reading the Fat. The column of fat should be read from the bottom line, where it meets the water, to the highest point where it joins the glass. The upper surface is curved, and quite often the test is read low by reading only to the lower part of the curve. It should be read as high as the fat goes. The same thing applies when reading tests of whey. It is quite often read two tenths when four tenths is the amount present. A pair of dividers will aid greatly. Open them to the full length of the fat column, then place the lower point on the zero line, and the upper point will show the per cent. present at a glance. When reading without dividers errors in subtraction may occur.

Testing Cheese. Cheese may be tested by the Babcock test for fat as well as milk. In making a milk test we take 17.6 c. c., or 18 grams. Cheese contains about one third fat, so that we cannot take 18 grams; but if we balance the bottle on a small scale, such as druggists use for prescriptions, and weigh in four or five grams of cheese, we will have a

convenient amount for the test. The cheese can be cut into small strips which will drop down the neck of the bottle. Then add fifteen cubic centimeters of boiling water and a few drops of ammonia, and shake till the cheese is dissolved into a creamy consistency. When the bottle is *cold* add acid, and test as though it were milk. The reading of the fat is then multiplied by $\frac{18}{a}$, a being the weight of cheese taken. The quotient will be the per cent. of fat in the cheese. If we weighed out five grams of cheese, and the reading of the fat is 7.1, we have $(7.1 \times 18) \div 5$, or 25.5% fat in the cheese.



TROEMNER'S BALANCE.

A little balance with weights and a bar, reading to one tenth of a gram, known as Troemner's balance, is sold by chemical supply houses for about eight dollars.

Quevenne Lactometer. As has been stated, the Quevenne lactometer reads specific gravities directly. On the scale are a set of figures reading from 15 down to 40. These figures mean thousandths, that is, 30 means 1.030 specific gravity. If we have a barrel that will hold 1,000 lbs. of water at 60° F., and fill it with milk that reads 30 on our lactometer, we would have 1,030 lbs. of milk in the barrel. Now, if the milk is heated up above 60°, one tenth of a pound will flow over the top for each degree above 60° F., and likewise for every degree the milk is lowered, a tenth of a pound more can be put into

the barrel. Sixty has been taken as an arbitrary standard of temperature for specific gravity of milk, and we must temper the milk near to that point. If it varies a few degrees, the reading can be corrected by adding or subtracting one tenth to the reading of the lactometer for every degree of variation in temperature. Thus: if the lactometer reading is 32, and the temperature 65° , add .5 to 32, which would make the corrected reading for 60° 32.5. The best lactometers have a thermometer connected, and it is not advisable to use any other.

Board of Health Lactometer. The Board of Health lactometer has an arbitrary scale reading from 0 to 120; 100 is a specific gravity of 1.029, which corresponds to 29 on the Quevenne scale. This is the lowest specific gravity known for pure milk, the average being about 1.032 sp. g. This scale can be converted into the Quevenne scale by multiplying the reading by .29. By so doing one can use the Board of Health instrument if a Quevenne is not available.

Detecting Watered Milk. The solids other than fat make the milk denser and raise the lactometer, while the fat makes it lighter and lowers the instrument. Each per cent. of fat lowers it seven-tenths of a degree. If we multiply the per cent. of fat found by the Babcock test and add the product to the lactometer reading it will give the reading of the milk if the fat were not present. This is the way to eliminate the effect of the fat. If the specific gravity of the other solids is divided by 3.8, the result will be per cent. of solids not fat.

For instance, the lactometer reading is 31.5, the temperature 65°, and the fat 4 per cent., what is the per cent. of solids not fat?

$31.5 + .5 = 32 + (4 \times .7 = 2.8) = 34.8 \div 3.8 = 9.10 + \%$
solids not fat.

If the solids not fat run below 8.5 per cent. fat it is very poor milk and probably watered.

If 8.5 per cent. solids not fat be taken as a basis for pure milk, and we find but 7.00 per cent. the way to get the amount of water added is readily found by proportion:

$$\begin{aligned} 7.0 : 8.5 :: x : 100 \\ 8.5x &= 700 \\ x &= .832 + \end{aligned}$$

From which 82.3 + % is the milk found to be present in the sample or 17.7 per cent. water has been added.

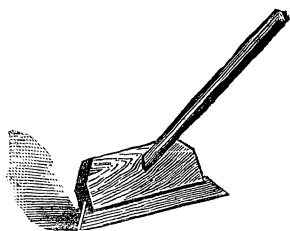
When patrons are paid by the fat test it does not pay to go to the trouble of hauling water to the factory.

CHAPTER IV.

OPERATING A FACTORY.

Now that we have our factory in proper trim for working, a few suggestions about the methods of operating may not be out of place. We will not take up the process of making cheese, as this has been fully treated in Part I.

Keep Clean. Cleanliness is the main factor underlying the whole dairy business, and we must keep our factory clean. Almost every cheese-maker will keep the inside of the weigh-can and cheese vats clean, but the outside is often sorely neglected. Milk may be spilled on the floor, and not properly cleaned up. Water is slopped on the floor, and the maker wades through it without drying it up; when the whey is



RUBBER MOP.

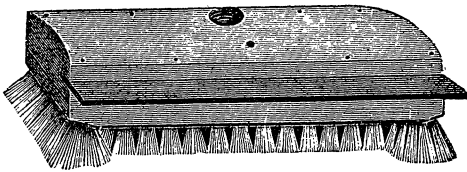
drawn from the vat, it often goes on the floor, and in order to keep his feet dry, he wears rubber boots.

Rubber Boots. The rubber boots are an injury to his health and the slop unnecessary, to say nothing about the wear on the floor and its nasty appearance. We would think a woman who kept her kitchen floor in such condition, a very untidy housewife, and I see no reason why a factory floor should be slopped over any more than a kitchen

floor. If any water accidentally gets onto the floor, it should be mopped up at once.

Scrubbing the Floor. At the close of the day's work, the floor can be scrubbed, first with lukewarm, and then with hot water, and then dried off with a rubber mop. Hot water will make the floor dry quickly, but it should never be used first where milk has been spilled, or where milk or whey is on tinware, for heat will scald the milk on.

Soaps. Powdered soap, such as "Gold Dust," is very effective in taking out dirt, but it is too expensive a



FLOOR SCRUB.

form in which to use soap, as it dissolves readily and runs away. Salsoda is much cheaper

and just as effective for a great many things, such as cleaning the floor. Sapolio is a soap mixed with infusorial earth, which may be used for scouring tinware.

Towels. Clean towels and clean cloths, for wiping utensils, are ornaments in a factory. Many a time has the writer been in a factory and looked for a towel without finding even a dirty one.

Several good scrubbing brushes are needed in a factory, and one of them should be of rice root for scrubbing cheese hoops and greasy articles.

In scrubbing the floor, the mop board should not be forgotten, nor the doors and other wood work. If the maker is careful in scrubbing the floor every day, a

general scrubbing once a week will keep things looking bright.

Shelves for Trinkets. The windows should be kept as clean as those in a dwelling house, nor should tools and little trinkets be laid on the window-sills. There should be shelves for all such things.

The curing room should likewise be kept in order. It should not be a dumping place for all sorts of material, which properly goes into the store room above.

How to Kill Moulds. If at the beginning of the season, the walls are sprinkled with water, and the room closed tight while two or three pounds of sulphur is burned in it, moulds will be killed.

Antiseptics. A still better way is to wash the walls with limewater. Limewater is a disinfectant, and should be used wherever it can be applied. Commercial sulphate of iron, or copperas or green vitriol, as it is commonly called, is also a disinfectant, and should be put into drains and places that are likely to smell bad.

To Prevent Dust. The boiler room must not be neglected. If coal is used, coal dust can be prevented by sprinkling the coal with water. The floor should be kept cleanly swept, and should be mopped twice a week, or as often as needed. Tools should have their regular places and be kept there.

The reader may think it a waste of space to talk about all these little matters, but experience has taught the writer that they are the foundation of the business of cheese making; and makers often fail, because they do not recognize the fact.

It is much easier to keep a clean factory than a dirty one, for the old saying that "an ounce of prevention is worth a pound of cure" is true here, as well as in other cases.

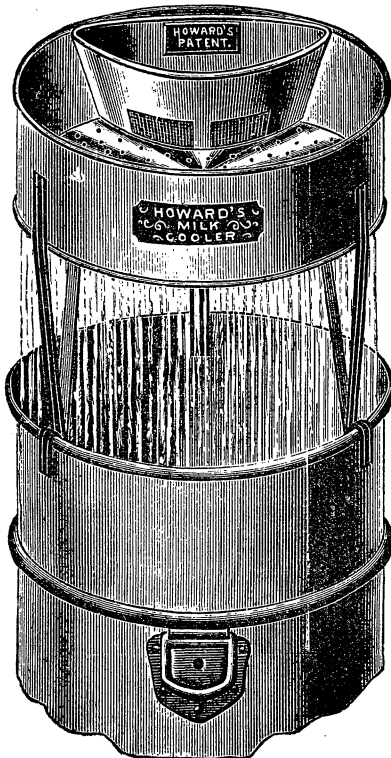
Factory Surroundings. Having got the inside of the factory clean, why not make the outside of it to match? Plant some trees, and in painting the factory, choose white or some light color, that will not absorb but reflect, the heat. A little extra effort may be put into graveling the roadways, to prevent them being cut up in wet weather. Level off the ground for a little space, seed it down, and cut the grass with a lawn-mower. If a dry spell comes we have plenty of water in our well, and can sprinkle the lawn with our steam pump. These things would take but little extra effort, and I think all will agree, that the result would fully repay the effort,

Why should it not be the rule that a cheese factory is to be kept not only clean, but attractive as well?

CHAPTER V.

THE MILK PRODUCER'S RESPONSIBILITY.

Aeration of Milk. During the last five years, the subject of aeration of milk has received a good deal of attention.



HOWARD'S AERATOR.

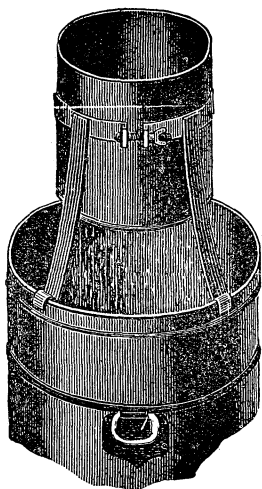
According to the old system of caring for milk, the patrons of a cheese factory were instructed to cool the milk as quickly as possible. Very often the milk was not properly cooled, and the milk would arrive at the factory sour.

We now hear cheese makers instructing their patrons to aerate their milk and not cool it, and many devices have been invented for this purpose.

Different Styles of Aerators. By aeration is meant,

that the milk is thoroughly exposed to the air. This may be done by pouring the milk with a large dipper, or allowing it to slowly trickle through small holes in a vessel, the fine streams of milk falling through the air into the milk can, or it may flow in a thin film over the surface of the apparatus, or air may be blown through the milk by means of an air pump.

What Aeration Does. By aerating the milk, animal odors and bad flavors escape. Of course the operation must be done in a sweet, clean atmosphere, or the milk will be inoculated with foul germs.



MILK AERATOR.

As a rule, milk that has been aired will keep sweet longer than milk that has not been aired, the conditions of temperature being the same, but the main advantage claimed for aeration is that the gases and bad odors escape, and the milk is better flavored.

In those factories where the patrons have practiced this, it has not been necessary to cool the milk, excepting for a few nights in the hottest weather.

It is a safe rule, however, to have the milk a little too sweet rather than a little too sour, but in the fall, when the nights are cool, patrons are inclined to continue cooling the milk, the same as in hot weather, and the cheese-maker is obliged to wait till afternoon for his milk to ripen, or he will have "sweet-cheese."

Keep Barn Clean. The great cause of bad milk is dirt. The barn should be kept scrupulously clean, and lime water, and other antiseptics, freely used. The cows catch a multitude of germs in their hair while moving around in the grass, especially in swampy ground, and the germs fall into the milk at milking time.

Their bellies and udders should be washed, as well as the hands of the milkers, and if the milk vessels have been washed clean and scalded, there will be little danger of foul milk.

Old Milk Cans to be Discarded. Milk cans which have passed their days of usefulness, and become rusty and cracked, should be discarded, for they often spoil more milk than ten new cans would cost. Such old cans will be tinkered up by putting a double bottom on, or a patch over a hole, under which patch or bottom the milk will soon find its way and cause trouble.

Wooden Milking Pails Should Not be Used. It sometimes happens that wooden pails are used for milking in. The milk gets into the cells of the wood, and into the joints, and ferments, and no matter what precautions are taken, such pails cannot be kept clean.

Patrons should be Educated. The patron has his share in the work of producing good cheese, by properly caring for the milk till it arrives at the factory, and while his intentions may be good, he is often unconscious of his errors, and the cheese-maker should endeavor to instruct him in the proper caring for milk.

Dairy Newspapers. We have spoken of educating the patrons and it may not be out of place to here remind the reader that the dairy newspaper is a great factor in dairy education. Get your patrons to subscribe for one or more strictly dairy papers and good fruit will be sure to come. The subscription price of a paper is often more than returned in one number.

The cheese maker himself should keep files of a number of these papers and a scrap book for clippings from the dairy columns of general agricultural papers. One often wants to refer to some article and he can soon find it if he keeps such a scrap book.

CHAPTER VI.

ORGANIZATION OF CHEESE FACTORY ASSOCIATION.

Cheese factories are operated on two plans, namely, the private and stock company systems. In the first named plan the factory is owned by an individual who furnishes everything in the manufacture, and receives a certain price per pound for such manufacture, the milk and the cheese being all the time considered the property of the patrons. The patrons then have some form of organization for the purpose of selling the cheese and dividing the money, and looking after their interests generally.

Under the other system the farmers' organization goes further and owns the factory, and the officers do all business and hire a cheese maker to manufacture the cheese.

The following by-laws will give a general idea of how to organize such an association:

BY-LAWS FOR A CHEESE FACTORY ASSOCIATION.

ARTICLE I. Name—This Association shall be known as the.....
.....Cheese.....Company.

ARTICLE II. Capital Stock—The capital stock of the Association shall be \$4,000, divided into two hundred shares of twenty dollars each.

ARTICLE III. Officers—The officers shall be a president who shall have general oversight of the business of the Association and prosecute any case at law that may arise. A treasurer who shall receive and disburse all money and keep a proper set of books which shall be

open to inspection of any member of the Association at any time. He shall be the salesman for the Association. He shall receive \$—— per annum for his services. A secretary who shall figure all milk dividends. He shall be Chairman of the Milk Committee.

ARTICLE IV. There shall be semi-annual meetings of the Association on the first Tuesday in March and October, three days notice of the time and place of meeting to be given by the president. Special meetings may be called by the president, three days notice of the time and place to be given, and upon the written request of ten members of the Association the president shall call such a meeting.

ARTICLE V. The division of money for cheese sold shall be determined by the fat test of the milk, after expense of making has been deducted. The remaining amount of money shall be divided by the number of pounds of butter fat delivered during the time said cheese was made to determine the price per pound of butter fat, and each patron shall receive that price per pound for the butter fat delivered by him during that time.

ARTICLE VI. Test Committee—There shall be a test committee of three members beside the secretary who shall assist the cheese maker in testing the milk.

ARTICLE VII. The price for making cheese shall be one and a half cents per pound.

ARTICLE VIII. The cheese maker may reject any milk that in his judgment will not make first class cheese.

ARTICLE IX. No milk will be received at this factory that has not been properly strained and aerated.

ARTICLE X. These by-laws may be altered at any legal meeting by a two-thirds vote of the members present, providing there are at least ten members present at such meeting.

The above by-laws can, of course, be changed to suit any particular locality or conditions. The amount of capital stock may be altered, or such articles changed as to make them suit a private factory.

Article VI, which organizes a test committee, is for the purpose of preventing dissensions. We quite often hear it stated that the maker reads the tests low to get a larger yield, or that he favors one patron more than

another. Such statements may be founded on facts, but are generally the results of suspicions. Now if the patrons have a committee of their number to see the tests made, such a committee can not fail to secure justice.

The matter of the number that shall constitute a quorum has been purposely left out, for in such an association it is not very important, and might hinder in the business of some meetings. The article on the revision of the by-laws contains a clause that practically names a quorum in such a case.

In some Canadian stock companies there are two rates charged for making the cheese, a stockholders' rate and a patrons' rate, which is higher than the former. The patron is not entitled to whey. It belongs to the corporation, to be fed to hogs owned by the association, or disposed of as the stockholders see fit. Each share of milk entitles the owner to have fifteen thousand pounds of milk made up at stockholders' rates, and after that he must either get another share of the stock or pay patrons' rate for all milk made up above that amount. The object of this rule is to make each patron take a financial interest in the factory.

Perhaps this is the proper place to speak of figuring dividends. As is indicated in one of the by-laws, the price per pound of butter fat should be found and each patron paid for the pounds of fat delivered by him.

Cheese may be sold each week, but the dividends made for the month.

The composite samples of milk are saved as described under the head milk testing, and tested once a week. The pounds of milk delivered by the patron multiplied by the per cent. of fat gives the pounds of fat delivered by him. The amount of money left after paying all expenses is then divided by the total pounds of fat for the month to get the price per pound of fat. And then the number of pounds of fat delivered by each patron, multiplied by the price per pound, gives the amount due him. Theoretically the pounds of milk delivered each week should be multiplied by the weekly test, but the tests from week to week if averaged together for the month, and then the monthly milk multiplied, will give very close to the amount found if each week's fat were found and added together for the month, and a large amount of labor is saved.

If there is a small surplus or shortage of money in figuring it can be added to or subtracted from the next month's money before determining the price per pound.

For an example of dividing money suppose there are three patrons, and during the month they deliver milk as follows:

A.....	3,000 lbs.	milk testing	4. 0 %	= 120 lbs. fat.
B.....	2,200 lbs.	" "	3. 5 %	= 77 lbs. fat.
C.....	1,000 lbs.	" "	4. 5 %	= 45 lbs. fat.
<hr/>				
Total for month..	6,200 lbs.	" "	3.90 %	= 242 lbs. fat.

By dividing the pounds of fat by the pounds of milk for the month and multiplying by 100 we get the average test of all the milk for the month. It is not needed in the figuring of the dividends, but it is interesting to know what the average test is.

Suppose the cheese made from the milk was 620 pounds and sold for 10 cents per pound. We then have \$62.00. The cost of making was \$9.30, and we have left \$52.70 to be divided among the patrons. By dividing this amount by the 242 pounds of fat we get 21.777 cents per pound. Then

A has 120 lbs. fat @ 21.777 cts. =	\$26.13240
B has 70 lbs. fat @ 21.777 cts. =	16.76829
C has 45 lbs. fat @ 21.777 cts. =	9.79965
Total.....	<u>\$52.70034</u>

We had \$52.70 to be divided. One should always prove his figures to be sure they are correct.

A statement containing all necessary items should be given each patron so that he can figure the dividend for himself. There should be a printed form for this. The following may be used:

MUSCODA CHEESE ASSOCIATION FACTORY.

Statement for.....
 Month of....., 18.....,
 Sales include following dates..... to.....
 No. pounds of cheese sold.... lbs.
 Amount of money received..... \$.....
 Average price per pound cts.
 No. pounds of milk delivered.....
 No. pounds of fat delivered.....
 Average test.....
 Expenses.....
 Money to be divided.....
 Which leaves..... cts. per pound of fat.
 No. pounds of milk delivered by you.....
 Your average test.....

CHEDDAR CHEESE MAKING.

131

Pounds of fat delivered by you
 At cents per pound..... \$.....
 Dr. by pounds of cheese at..... cts. per pound
 Money due you.....
 No. pounds of fat required for 1 pound cheese.....
 No. pounds of cheese from 100 pounds milk.....

..... Sec.

PART III.

Questions for Aiding in a More Thorough Study of the Subjects Treated in Parts I and II.

The answers to these questions will be found on the pages indicated at the end of the questions.

MILK.

1. What is milk? p. 1.
2. What substances are found in milk? p. 1.
3. How much water is there in cow's milk? p. 1.
4. How much ash is there in cow's milk? p. 1.
5. What is the ash of milk? p. 2.
6. How much albuminous substance is there in milk? p. 2.
7. What is the difference between albumen and casein? p. 4.
8. How much sugar is there in milk? p. 1.
9. How does milk sugar compare with cane sugar? p. 1.
10. How much fat is there in cow's milk? p. 1.
11. What proportion of the milk is solids? p. 1.
12. What substances are in solution? p. 4.
13. What is an emulsion? p. 2.
14. What substance is in emulsion? p. 2.
15. What is the size of fat globules in cow's milk? p. 2.
16. What is colostrum milk? p. 3.

17. How does colostrum differ from normal milk?
p. 3.
18. Why should not colostrum milk be used for making cheese? p. 3.
19. How long after calving before cow's milk can be used for cheese? p. 3.
20. What is whey? p. 4.
21. What is curd? p. 4.
22. What does the fat of milk do in a cheese? p. 4.
23. What determines the value of milk for cheese?
p. 4.

FERMENTATIONS OF MILK.

24. What change does casein undergo in the manufacture of cheese? p. 6.
25. What are the two general classes of ferments?
p. 6.
26. What are organized ferments? p. 6.
27. Describe the structure of a bacterium. p. 8.
28. What is the difference between bacilli, cocci and yeasts? p. 8.
29. What is the cause of nearly all the trouble we have in making cheese? p. 6.
30. Could we make good cheese without bacteria?
p. 6.
31. What are the desirable flavors in cheese? p. 6.
32. What is the lactic ferment and what substance in the milk does it attack? p. 6.
33. What is the most important point in cheese making? p. 7.
34. What is the cause of pinholes in cheese? p. 7.

35. What is the difference between "pinholes" and "Swiss holes?" p. 7.
36. What is the butyric fermentation? p. 7.
37. What is the alkaline curdling of milk? p. 7.
38. What are "ropy" and "slimy" milks, and how are they caused? p. 8.
39. What is the cause of bitter milk? p. 7.
40. What are unorganized ferments? p. 9.
41. What is the test for distinguishing between organized and unorganized ferments? p. 9.
42. What is an enzyme? p. 9.
43. What kind of ferments are rennet and pepsin? p. 9.
44. Are enzymes ever produced by organized ferments? p. 9.
45. Where is rennet found? p. 10.
46. How does rennet curdle milk? p. 10.
47. What salts will curdle milk? p. 10.
48. What is the effect of heat on the action of rennet? p. 10.
49. At what temperature is rennet destroyed? p. 11.
50. What is the effect of the acidity of milk on the action of rennet? p. 11.
51. How does acid or alkali artificially added to the milk operate on the action of the rennet? p. 11.
52. Does rennet exhaust itself in its action? p. 11.
53. What is rennet extract? p. 12.
54. Are different lots of rennet extract alike? p. 11.
55. What is the cause of varying strength of rennet extract? p. 11.
56. How is rennet extract made? p. 12.

- 57. Why should not whey be used to soak rennets in? p. 13.
- 58. Why is it better to buy reliable rennet extract rather than make it ourselves? p. 13.

THE RENNET TEST.

- 59. What is the cause of "Swiss holes?" p. 14.
- 60. On what three factors is rennet action dependent? p. 14.
- 61. If we use the same rennet, at the same temperature of the milk each time, what is variation with which it coagulates the milk due to? p. 15.
- 62. Who was the discoverer of the rennet test, and what did he first use for measuring the rennet and milk? p. 15.
- 63. What proportion of rennet to milk do we use in making cheese? p. 15.
- 64. What is the objection to using glass graduates for measuring rennet and milk? p. 15.
- 65. What is the Monrad rennet test? p. 16.
- 66. How is the rennet and milk measured in the Monrad test, and what is the object in diluting the rennet? p. 17.
- 67. Why should the milk be stirred with a thermometer, when making the rennet test? p. 18.
- 68. At what temperature should a rennet test be made? p. 18.
- 69. What precautions should be taken in making a rennet test? p. 17.

70. What does the rennet test tell us, and to what point should the milk be ripened each day?
p. 18.
71. Starting with the season's work, how does a maker find to what number of seconds he must ripen his milk? p. 19.
72. What is a starter and why do we use one? p. 19.
73. How is a starter prepared? p. 24.
74. Why should we not save a starter from the vat?
p. 25.
75. Why should we not use whey for a starter? p. 25.
76. How do we compare rennet extracts? p. 20.
77. What two conditions must always be alike, and what is the third factor we seek, when comparing rennet extracts? p. 20.
78. Suppose we have two kinds of rennet extract, A and B, offered to us, the price of A being \$1.50 per gallon, and B \$1.25. On making comparative tests we find A coagulates the milk in thirty seconds, and B in fifty seconds. Which is the cheaper extract? p. 20.
79. C sells an extract for \$1.35 per gallon and D sells one for \$1.45. C's extract coagulates the milk in seventy seconds, while D's extract takes sixty seconds. What will C's extract be worth when compared with the price of D's extract, and what will D's extract be worth when compared with C's? p. 21.
80. (a) With the rennet test, E extract coagulates the milk in 80 seconds, and F extract coagulates it in 100 seconds. With E extract three

- ounces will coagulate 1000 lbs. of milk in twenty minutes. How long will it take four ounces of F extract to coagulate 1000 lbs. of milk? (b) How much F extract must we use to coagulate 1000 lbs. of milk in twenty minutes? p. 20.
81. If the rennet test of A is thirty seconds, and B fifty seconds, and four ounces of A will coagulate 1,000 lbs. of milk in 20 minutes, how long will it take five ounces of B? p. 21.
82. In what terms should the action of rennet be expressed? p. 21.

FIRST STEPS IN CHEESE MAKING.

83. If a maker is suspicious that his milk is over ripe, what is the first thing he should do? p. 23.
84. What is the effect of over ripe milk on the yield of cheese? p. 24.
85. What is the usual loss of fat in the whey of normal working milk?
86. At what temperature should the milk be set? p. 26.
87. What would be the effect of setting milk at 98°F.? p. 26.
88. How much rennet should be used for a fast curing cheese? p. 26.
89. How much rennet should be used for a slow curing cheese? p. 26.
90. How should rennet be diluted before adding to the milk? p. 26.

- 91. How long should the milk be stirred after adding the rennet? p. 27.
- 92. Why do we stir the milk after adding the rennet? p. 27.

CUTTING THE CURD.

- 93. When is the curd ready to cut? p. 27.
- 94. In cutting the curd, which knife is used first? p. 28.
- 95. How is the knife inserted and withdrawn from the curd? p. 28.
- 96. What is the effect of jamming the curd? p. 28.
- 97. How many times should a curd be cut? p. 30.
- 98. How should a fast-working curd be cut? p. 28.

HEATING THE CURD.

- 99. Why do we heat a curd? p. 31.
- 100. How fast should a curd be heated? p. 31.
- 101. What would be the effect of heating a curd too fast? p. 31.
- 102. When should we begin heating the curd? p. 31.
- 103. How should we heat an over ripe curd? p. 31.
- 104. What would be the effect of heating a normal-working curd up to 108°F.? p. 33.
- 105. What is a "corky" cheese? p. 33.
- 106. How high should a normal-working curd be heated? p. 33.
- 107. Why is a correct thermometer a necessity? p. 33.
- 108. What would be the effect, if a curd were not stirred after cutting? p. 31.
- 109. How is the curd stirred? p. 34.

- 110. Describe a McPherson curd-rake. p. 34.
- 111. How can we tell when a curd is properly cooked?
p. 35.

DRAWING THE WHEY.

- 112. When should the whey be drawn from the curd? p. 36.
- 113. What is meant by "an eighth of an inch" of acid? p. 36.
- 114. Can a curd that will string, be made from milk fresh from the cow? p. 36.
- 115. What is the effect of too much acid on a curd and in the cheese? p. 37.
- 116. If we find we have an over ripe curd how should it be treated? p. 37.
- 117. How much acid may be run in the whey without injury to the curd? p. 37.
- 118. Why do we use curd racks? p. 37.
- 119. Describe a curd rack. p. 37.
- 120. What kind of cloth is used on the curd racks?
p. 38.
- 121. How are the racks put into the vat? p. 38.
- 122. Why do we cut the curd on the racks into blocks?
p. 39.
- 123. How should the curd on the racks be turned?
p. 39.
- 124. How often should a curd on the racks be turned?
p. 40.
- 125. How should a curd with pin-holes in it be handled? p. 38.
- 126. If a curd is tainted, how should it be treated?
p. 40.

- 127. When is the best time to wash a tainted curd?
p. 40.
- 128. What are the causes of tainted curds? p. 41.
- 129. When should cabbages, turnips, and such foods,
if fed at all, be given to the cows? p. 41.
- 130. What is a curd sink? p. 42.
- 131. What are the common defects of curd sinks?
p. 42.
- 132. How should a curd sink be built? p. 42.
- 133. In what way is a curd sink an advantage over
racks in the vat? p. 42.
- 134. How should the curd be dipped into the curd
sink? p. 42.
- 135. Why should the curd be kept warm? p. 43.
- 136. How high should a curd be piled? p. 43.
- 137. Should an over ripe curd be piled? p. 43.

MILLING THE CURD.

- 138. When is a curd ready to mill? p. 44.
- 139. How much acid should a curd have when ready
to mill? p. 44.
- 140. Describe the common peg mill. p. 44.
- 141. Describe the Pohl mill. p. 46.
- 142. Describe the McPherson mill. p. 47.
- 143. Describe the Harris mill. p. 47.
- 144. Describe the common knife mill. p. 46.
- 145. What are the objections to peg mills? p. 44.
- 146. What are the objections to knife mills? p. 48.
- 147. What are the advantages of knife mills? p. 48.
- 148. Why do we stir the curd after milling? p. 49.

149. What is a convenient tool for stirring the curd?
p. 49.
150. If a curd is very gassy, how can the gas be gotten rid of? p. 49.
151. What is the effect of dry acid on a cheese, and how much acid should a curd have when put to press? p. 50.
152. Is there any danger of getting too much "dry acid" in a curd? p. 50.

SALTING THE CURD.

153. What are the four tests to determine when a curd is ready to salt? p. 51.
154. What is common salt? p. 51.
155. Where is salt found? p. 51.
156. What are the impurities in salt? p. 52.
157. What is the effect of calcium chloride in salt?
p. 52.
158. What is the effect of salt on the curd? p. 53.
159. What is the effect of too much salt in cheese?
p. 53.
160. How does salt affect the yield of cheese? p. 54.
161. How much salt should be used for a fast curing cheese? p. 55.
162. How much salt should be used for a slow curing cheese? p. 55.
163. Should a moist curd be salted the same as a normal curd? Why? p. 55.
164. How should salt be applied to a curd? p. 55.
165. What should be the temperature of the curd when salted? p. 55.

166. What should be the condition of a salted curd, when ready for the press? p. 56.

PRESSING THE CHEESE.

167. At what temperature should a curd be put to press? p. 57.
168. If a curd is too warm when put to press, what is the effect? p. 58.
169. If a curd is too cold, what difficulty is met in pressing? p. 58.
170. What are the common packages for American cheese? p. 58.
171. What are the two kinds of presses used? p. 58.
172. What is the objection to a gang press? p. 59.
173. What two kinds of cheese bandage are used? p. 60.
174. What is the objection to starched bandage? p. 60.
175. How may a cheese that fails to close in the hoop be closed? p. 60.
176. How far should the bandage lap over onto the ends of the cheese? p. 60.
177. What are cheese cloth circles? p. 65.
178. Should a circle lap over or under the bandage? p. 65.
179. How large should a circle be? p. 65.
180. Why should not square press cloths be used? p. 60.
181. How full should a cheese hoop be filled? p. 61.
182. How fast should a press be tightened? p. 61.
183. How should a cheese be "dressed?" p. 62.

- 184. Why should the bandages be put into the hoops, after dressing the cheese? p. 62.
- 185. Why do we press a cheese? p. 62.
- 186. Why should two flats not be pressed in a cheddar hoop? p. 101.
- 187. If cheese stick to the hoops, how should the hoops be treated? p. 63.
- 188. What is the effect of pounding the hoops, to get the cheese out? p. 63.
- 189. What is the objection to using a knife to get the cheese out? p. 63.
- 190. How often should the hoops be washed? p. 63.
- 191. When and why do we grease the rinds of a cheese? p. 64.
- 192. What makes cheese crack? p. 64.
- 193. What is the objection to a cracked cheese? p. 64.
- 194. What is the effect of high acid in cheese placed in cold storage? p. 64.
- 195. How can mouldy cheese be cleaned? p. 65.
- 196. How can mould, to a large extent, be prevented from forming on cheese? p. 66.
- 197. Why should a daily record of the making be kept? p. 67.

CURING OF THE CHEESE.

- 198. What is the proper temperature for a curing room? p. 68.
- 199. Why is fresh air needed in curing cheese? p. 68.
- 200. Why should the younger cheese be placed on the upper shelves? p. 69.
- 201. How old should a cheese be, before shipping? p. 69.

- 202. Why is a ripe cheese easier digested than a green one? p. 69.
- 203. What is a hygroscope or hygrometer? p. 70.
- 204. What is a psychrometer? p. 70.
- 205. What is the principle on which the hygrometer works? p. 70.
- 206. What is the principle on which the psychrometer works? p. 70.
- 207. What is meant by relative humidity? p. 71.
- 208. How should the psychrometer reading be taken? p. 71.
- 209. What should be the relative humidity in the curing rooms? p. 75.
- 210. What may be the relative humidity in dry weather? p. 75.
- 211. What should be done in very moist weather to keep cheese from moulding? p. 75.
- 212. How can moisture be supplied to a curing room? p. 75.
- 213. How large should the cloths be? p. 76.
- 214. If the cloths get stiff from sediment, how should they be treated? p. 76.

SHIPPING THE CHEESE.

- 215. How are cheese boxed for shipping? p. 77.
- 216. What are scale boards? p. 77.
- 217. How many scale boards should be used on the ends and between the cheese? p. 77.
- 218. Why are scale boards used? p. 77.
- 219. How and why should boxes be trimmed? p. 77.
- 220. Why should not a poor box be used? p. 78.

- 221. What is the penalty in Wisconsin for making adulterated cheese? p. 81.
- 222. How are cheese weighed? p. 78.
- 223. How and where should the weights of cheese be marked on the boxes? p. 78.
- 224. How are cheese sold? p. 79.

JUDGING CHEESE.

- 225. What are the points in scoring cheese? p. 82.
- 226. What importance is attached to the flavor of a cheese? p. 83.
- 227. What is considered a good flavor? p. 83.
- 228. Can the flavor of a cold cheese be readily detected? p. 83.
- 229. How is a plug pulled from a cheese? p. 82.
- 230. Of how much importance is the texture of a cheese? p. 83.
- 231. What are the qualities of a good texture? p. 84.
- 232. Of what importance is salt in the scoring of a cheese and how is it determined? p. 84.
- 233. Of what importance is the color of a cheese? p. 85.
- 234. What should be the color of a cheese to which no color has been artificially added? p. 85.
- 235. How can we tell the quality of a cheese from its outside appearance? p. 85.
- 236. If a cheese is mottled on the rind, what does it indicate? p. 85.
- 237. Where should a cheese be plugged? p. 83.
- 238. What is meant by quality according to the English scale of judging? p. 86.

PART II.**THE CONSTRUCTION OF FACTORIES.**

- 239. How, in their construction, are cheese factories usually wrong? p. 88.
- 240. What is usually the trouble with the curing room? p. 88.
- 241. What is usually wrong about the whey tank? p. 89.
- 242. Why is hot water a necessity in a factory? p. 89.
- 243. What is the first thing necessary in building a factory? p. 92.
- 244. How should the walls of a factory be built? p. 93.
- 245. How should the ceiling and floor of the curing room be constructed? p. 93.
- 246. How should fresh air be supplied to a curing room? p. 95.
- 247. What is a sub-earth duct? p. 95.
- 248. How should the doors of the curing room be constructed? p. 94.
- 249. How should a sub-earth duct be built? p. 96.
- 250. Of what kind of material should the curing shelves be made, and what should be their dimensions? p. 103.
- 251. What kind of a floor should there be in the making room? p. 93.
- 252. How should the water tanks to the vats be made? p. 100.

EQUIPMENT.

- 253. Why is a whey-gate necessary on a cheese vat? p. 100.

254. How should the wash sink be constructed?
p. 101.
255. What kind of a gang-press should we have?
p. 59.
256. How should the boiler room be lined? p. 97.
257. How should the sewer be constructed? p. 98.
258. What is a blind well? p. 98.
259. How should a blind well be ventilated? p. 99.
260. How should the whey tank be constructed? p. 85.
261. How often should the whey tank be cleaned out?
p. 99.
262. How should the floors be kept clean? p. 119.
263. What is a sewer trap? p. 99.
264. How can the whey be elevated to the whey tank?
p. 99.
265. Why should steam be used in a factory? p. 89.
266. How can the milk be lifted to the weigh can?
p. 102.

MILK TESTING.

267. Is it doing justice to pay for milk according to its fat content? p. 105.
268. How much cheese can be made from 100 lbs. of separator skim milk, in which there is no fat left? p. 105.
269. How much money will such skim milk cheese be worth? p. 105.
270. Would it not pay better to feed such milk to hogs?
p. 105.
271. How much cheese will 100 lbs. of 4 per cent. fat milk make? p. 105.

- 272. How much money will well made cheese from 4 per cent. fat milk bring? p. 105.
- 273. According to the answers to questions 267 to 272,—what is the most valuable part of the milk for cheese? p. 105.
- 274. Is the yield of cheese proportional to the fat content of the milk? p. 108.
- 275. What work has been done relative to the effect of fat on the yield of cheese? p. 106.
- 276. Who was the first man to pay for milk for cheese according to test? p. 106.
- 277. How should samples of milk be taken and preserved, for a composite test to be made once a week? p. 109.
- 278. How should the sample jars be marked? p. 109.
- 279. What small utensils are important in a factory? p. 103.
- 280. When was the Babcock test invented? p. 110.
- 281. What are the parts of the Babcock test? p. 111.
- 282. What weight of average milk does the pipette hold? p. 114.
- 283. What kind of acid is used in the test? p. 112.
- 284. What strength of acid is required? p. 113.
- 285. How will the test act if the acid is too weak? p. 113.
- 286. How will the test act if the acid is too strong? p. 113.
- 287. What will cause black specks in the fat? p. 113.
- 288. How should one read the fat? p. 114.
- 289. How can cheese be tested with the Babcock test? p. 114.

- 290. What distinguishes the Quevenne from other lactometers? p. 115.
- 291. On what is the Board of Health lactometer based? p. 116.
- 292. What is the standard temperature for specific gravity reading? p. 116.
- 293. How much variation in the lactometer reading does one degree make? p. 116.
- 294. What is the average specific gravity of milk? p. 116.
- 295. What is the effect of fat on the lactometer reading? p. 116.
- 296. How much does each per cent. of fat lower the lactometer reading? p. 116.
- 297. How do we find the solids not fat in milk? p. 116.
- 298. How low can solids not fat be in pure milk? p. 117.
- 299. If the standard of solids not fat be 8.5% and we find but 7% present, what per cent. of water has been added to the milk? p. 117.
- 300. What is the need of rubber boots in a cheese factory? p. 118.
- 301. Where should small trinkets in a factory be placed? p. 120.
- 302. What chemicals are good antiseptics, and how should they be used? p. 120.
- 303. How may coal dust be prevented? p. 120.
- 304. How should the outside of the factory be kept? p. 121.

305. What color should a factory be painted, and why? p. 121.

CARE OF MILK.

306. What was the old method of caring for milk, at the farm, before delivery to the factory? p. 122.
307. What objections are there for closing the milk up tight, and putting cold water around the milk can? p. 122.
308. What is meant by aerating milk? p. 122.
309. How is milk aerated? p. 122.
310. Why is milk aerated? p. 123.
311. Should the morning's milk be aerated? p. 123.
312. Where should milk be aerated? p. 123.
313. What would be the effect of airing milk in a foul smelling place? p. 123.
314. What advantage is claimed for aerated milk? p. 123.
315. Why should milk not be cooled in cold fall weather? p. 123.
316. What is the great cause of bad milk? p. 124.
317. Why should the cow's udder and belly, and the milker's hands be washed? p. 124.
318. Where do the cows get the bad bacteria? p. 124.
319. How should the barn be kept to secure good milk? p. 124.
320. How should the milk cans and milk pails be cleaned? p. 124.

- 321. What is the difficulty with old, patched up milk cans? p. 124.
- 322. Why should wooden pails not be used for milking in? p. 124.

CHEESE FACTORY ASSOCIATION.

- 323. On what two general plans are cheese factories operated? p. 126.
- 324. Why do patrons in some factories pay a higher rate for making than stockholders? p. 128.
- 325. Why is a test committee a good thing? p. 127.

The author recommends the following dairy books:

Dr. H. L. Russell's Dairy Bacteriology.

This book was written by Dr. Russell for instructional purposes in the subject indicated by the title in the Wisconsin Dairy School. It is a companion book to Cheddar Cheese Making. Price postpaid \$1.00. Address Dr. H. L. Russell, Experiment Station, Madison, Wis.

Adolph Schoenman's Milk-Test.

Written for use by the Wisconsin Dairy School students. Price postpaid 75 cts. Address A. Schoenman, Plain, Sauk Co., Wis.

Prof. F. W. Woll's Principles of Dairy Practice.

A translation of Grotenfelt, the noted Finnish dairy authority. Price postpaid \$2.00.

Dairy Calendar, by the same author, published annually.

Prof. Woll has been assisted by prominent dairy-men in editing this neat little calendar, and it contains a large amount of information that every dairyman ought to have. Price \$1.00 postpaid. Either of these books may be had by addressing Prof. F. W. Woll, Experiment Station, Madison, Wis.

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